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Handwoven, Three-dimensional, Multi-layered Textile Forms: A Processual Study

by

Joëlle Angela Renzi ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Science

in

Clothing and Textiles

Department of Human Ecology

Edmonton, Alberta

Spring 1996

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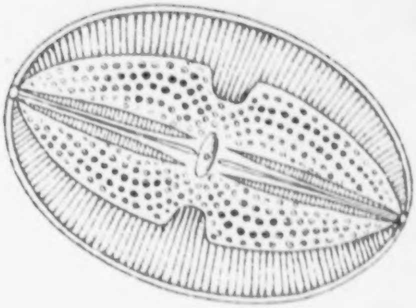

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1790 Broadmead Avenue
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ABSTRACT

A human ecology framework and a holistic approach were used to explore the processes involved in creating handwoven three-dimensional, multi-layered, textile forms. Visual and literary data from areas such as architecture, art, nature, the technology of woven textile structures and fibre art conservation were collected, reviewed and summarized.

My personal creative design processes were examined and documented through sketch development, computer weave drafting, and intuitive decision making. Five textile sculptures were produced on a multi-harness floor loom. The relationship between internal and external spatial compositions created during the installation and exhibition of the forms was explored and documented.

The conclusion focuses on the impact of handweaving technology and its possible future uses in the woven textile industry. Relatively new industrial applications of three-dimensional shaping techniques combined with inventive computer aided design programs, may lead to imaginative directions for both textile artists and industrial designers.

ACKNOWLEDGEMENTS

There were many people who were instrumental in the successful completion of my thesis and to whom I wish to express my gratitude.

I am indebted to my thesis advisor, friend and saviour Prof. Anne M. Lambert for graciously agreeing to supervise my program with positive energy when I was experiencing confusion and frustration at the onset of my second year. To my other committee members, new and original, many thanks for their encouragement and time; Marlene Cox-Bishop for her artistic advice and assurance, Pat Rafferty for her helpful suggestions prior to relinquishing her position on my committee due to early retirement, and David Lovett for rescuing me by taking her place at the last minute.

Invaluable assistance was given to me by my fellow grads and friends who were there to procrastinate with, help with thesis edits, and lend a sympathetic ear. This thesis would never have been completed if it weren't for Yolanda Olivotto's friendship and amazing problem solving skills and Joan Vanterpool's weaving wisdom, thank-you so much for your friendship and guidance through technical weaving confusions. Thanks also to technical wizard, Suzanne McLean for her computer expertise, assistance and patience. I would be lost without the two Lauries (Laurie Boone and Laurie Hart), thanks for being there with extensive knowledge, encouragement and cameras. Thank-you to Effy Katahan, Mari Bergen, and Susan Sanders and her Dad for being around to help when no one else was. Thanks to Laurie H. and Paige Myers for helping me photograph the Clothing and Textile Collection pieces and set up my works. To Greig Blamey and Sabrina Virdis thanks for being great roomies and assisting me with the set up of the African exhibit. I would also like to thank the guys who helped me move the "beast", even through all their complaining.

Thanks especially to my partners in crime, Kerry Maguire and Mickie Zerwig, for your wisdom, good humour, and Friday night binges, you were great

sources of inspiration and procrastination. I definitely wouldn't have made it without you. Also, heartfelt thanks to the Maguire's who adopted me while I was living here in Alberta.

I wish to express my thanks to the Nova Scotia Talent Trust for helping me begin my graduate program, the Handweaver's Guild of America for the HGA scholarship, the Alberta Museums Association for awarding me an individual training grant, and Subtext for their enthusiasm and great loom rental deals.

This thesis has relied strongly on the images of various artists' works and architecture and I am indebted to the artists and publishers who have given me permission to reproduce them.

Most importantly, I dedicate this thesis to my parents in Nova Scotia who supplied me with the necessary funds whenever possible, supported me over a long distance and who believed in me. I did it!!

> "*I spent four years prostrate to the higher mind,*
> *Got my paper and I was free!*"
> ~Taken from Closer to Fine, lyrics by E. Saliers.

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INTRODUCTION

I have often been asked why I use textiles as my medium to create three-dimensional sculptures as opposed to stone, metal, or ceramic. Sculptors, and those who view sculpture, often have a "taken-for-granted" view, assuming that sculpture can only be composed of hard materials such as granite, steel, wood and clay. This traditionally biased view of what constitutes sculpture is a popular misconception.

At the turn of the century, artists such as Braque and Picasso turned the art world on it's head with the introduction of their mixed media collages, shifting the traditionally two-dimensional into three-dimensional relief. A turning point such as this sent contemporary art ideals into flux, instigating debates among the artistic communities around the world. Is it sculpture? Is it painting? Is it drawing? Or in the case of Marcel Duchamp's found objects circa 1917 (eg. "Fountain"; a painted men's room urinal), is it art or waste?

Twentieth century artists began to move away from materials traditionally thought of as the only media with which a sculpture could be created, such as marble or bronze, to materials traditionally thought of as too fragile for sculpture, such as chair caning or cloth. In 1962, Claus Oldenburg and his giant "soft-sculptures" revolutionized contemporary attitudes towards traditional sculpture by offering a new slant on three-dimensional form. Why not recreate a traditionally accepted form such as a ceramic toilet, with non-traditional materials - vinyl? Successful artworks such as these, introduced three-dimensionality to artists working in another conventionally constrained medium, weaving.

Artistic Evolution of Handweaving

Constantine and Larsen (1981) traced the evolution of "art fabrics" from the early twentieth century through the 1950's, 1960's, and 1970's. As this book was written 14 years ago, art fabrics from the early 80's were excluded from their discussion. Only a few of the works included in this text fell under the category of double weaves, including dimensional pieces such as; Warren

Seelig's double plain weave structures using vinyl inclusions stuffed between the layers to create crisp pleats and rigid forms (see Figure 1), Kay Sekimachi's translucent multiple-layered monofilament pieces (see Figure 2) and Dominic di Mare's sequentially, not simultaneously, woven multi-layered pieces (see Figure 3). When hung freely in space these woven forms become fully dimensional.

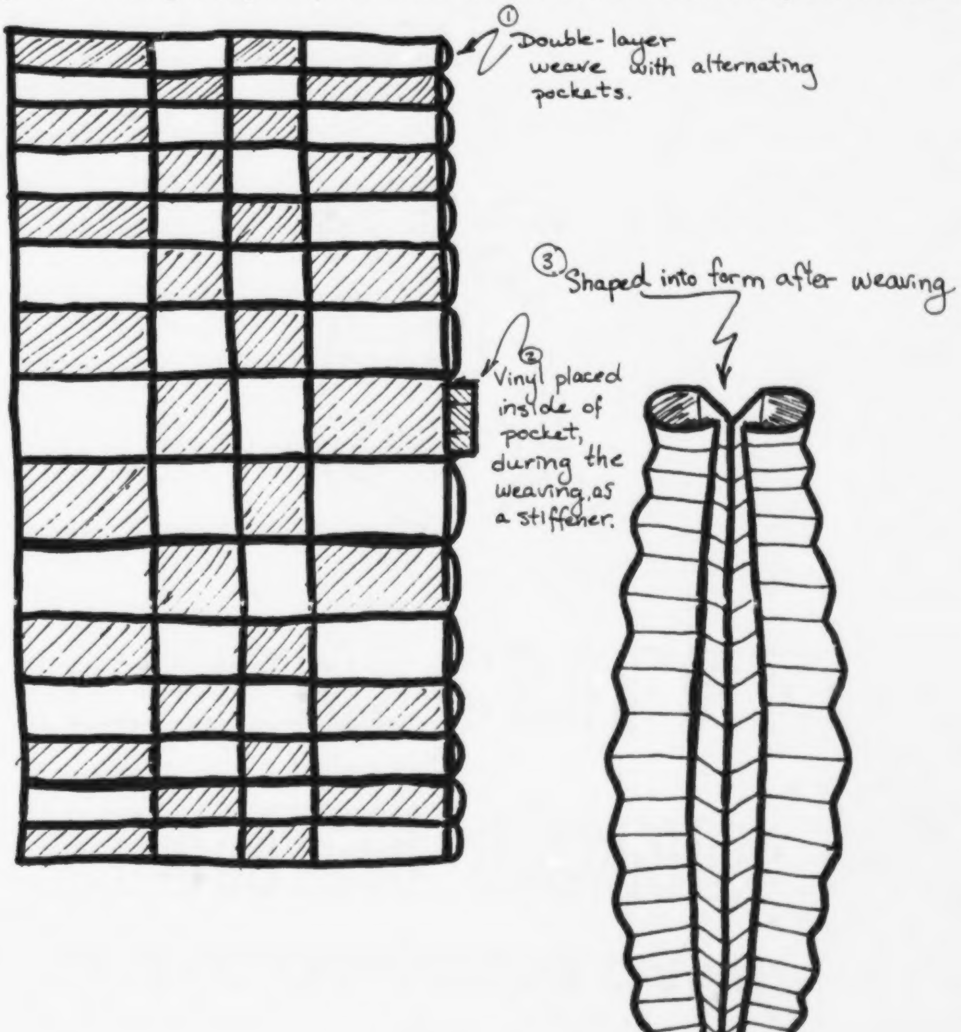
①
Double-layer weave with alternating pockets.
②
Vinyl placed inside of pocket, during the weaving, as a stiffener.
③
Shaped into form after weaving

Figure 1. Structural analysis of a stiffened double weave form by Seelig adapted from The art fabric: Mainstream by Constantine & Larsen, 1981, p.181(Sketch by J.A. Renzi, 1996).

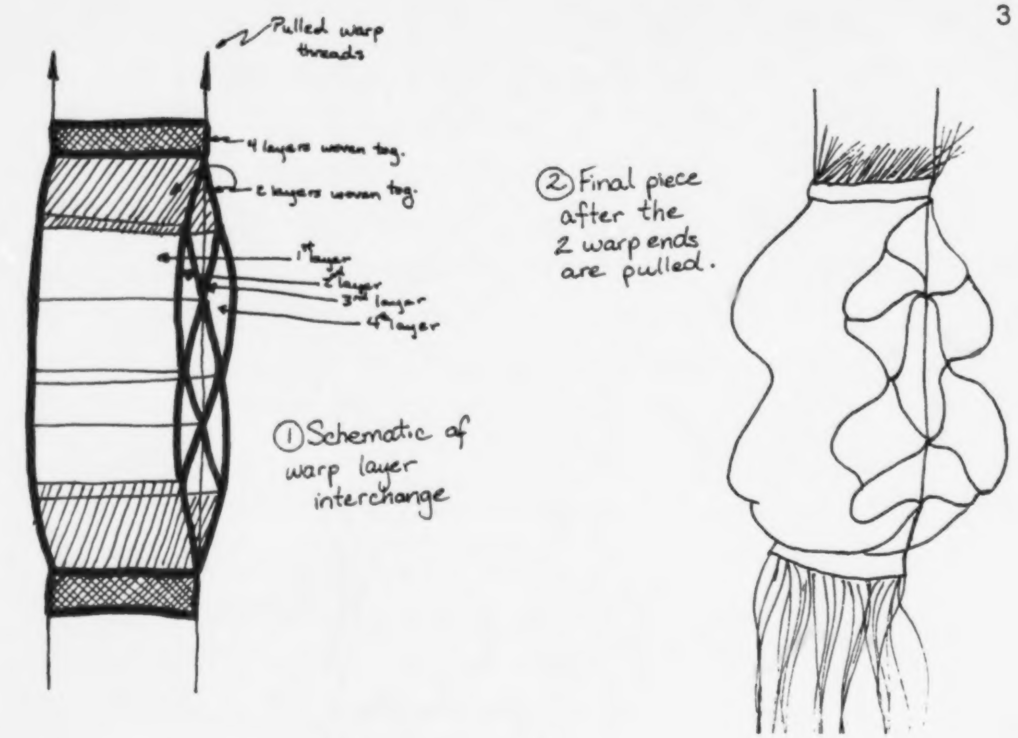
Pulled warp threads
4 layers woven tog.
2 layers woven tog.
1st layer
2nd layer
3rd layer
4th layer
① Schematic of warp layer interchange
② Final piece after the 2 warp ends are pulled.

Figure 2. Technical analysis of Sekimachi's monofilament multi-layered cloth *Shiratake III, 1965*, adapted from Beyond craft: The art fabric by Constantine & Larsen, 1972, p.259 (Sketch by J.A. Renzi, 1996).

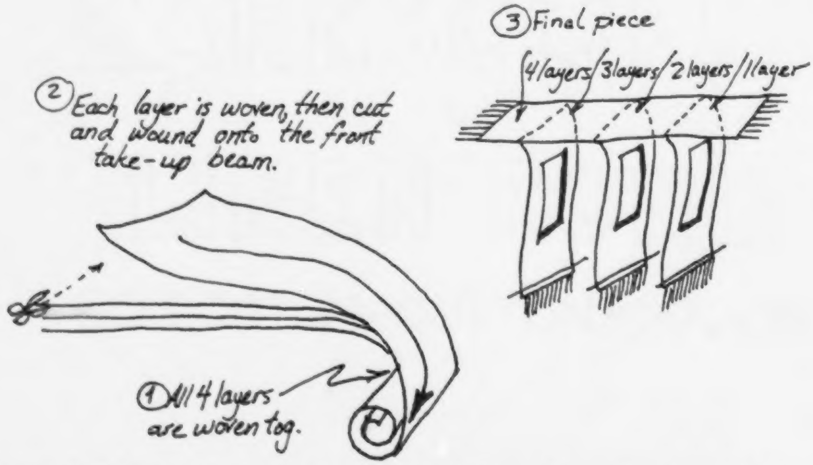
③ Final piece
4 layers
3 layers
2 layers
1 layer
② Each layer is woven, then cut and wound onto the front take-up beam.
① All 4 layers are woven tog.

Figure 3. Technical analysis of how di Mare's three-dimensional weaving *Box, 1963*, is produced, adapted from Beyond craft: The art fabric by Constantine & Larsen, 1972, p.49 (Sketch by J.A. Renzi, 1996).

Brostoff (1979) stated, "as a form of expression, the challenge of sculptured fiber, whether in the round or in relief, is one that has been least explored by fibre artists" (p. 2). This statement was made after the fibre art movement of the 1960's when weavers such as Magdalena Abakanowicz, Jagoda Buic and Claire Zeisler (see Figures 4, 5, & 6) were moving off the loom and into three-dimensional space. This off-loom phenomenon incorporated natural fibre and handweaving techniques used in the production of enormous, raw, organic textile forms.

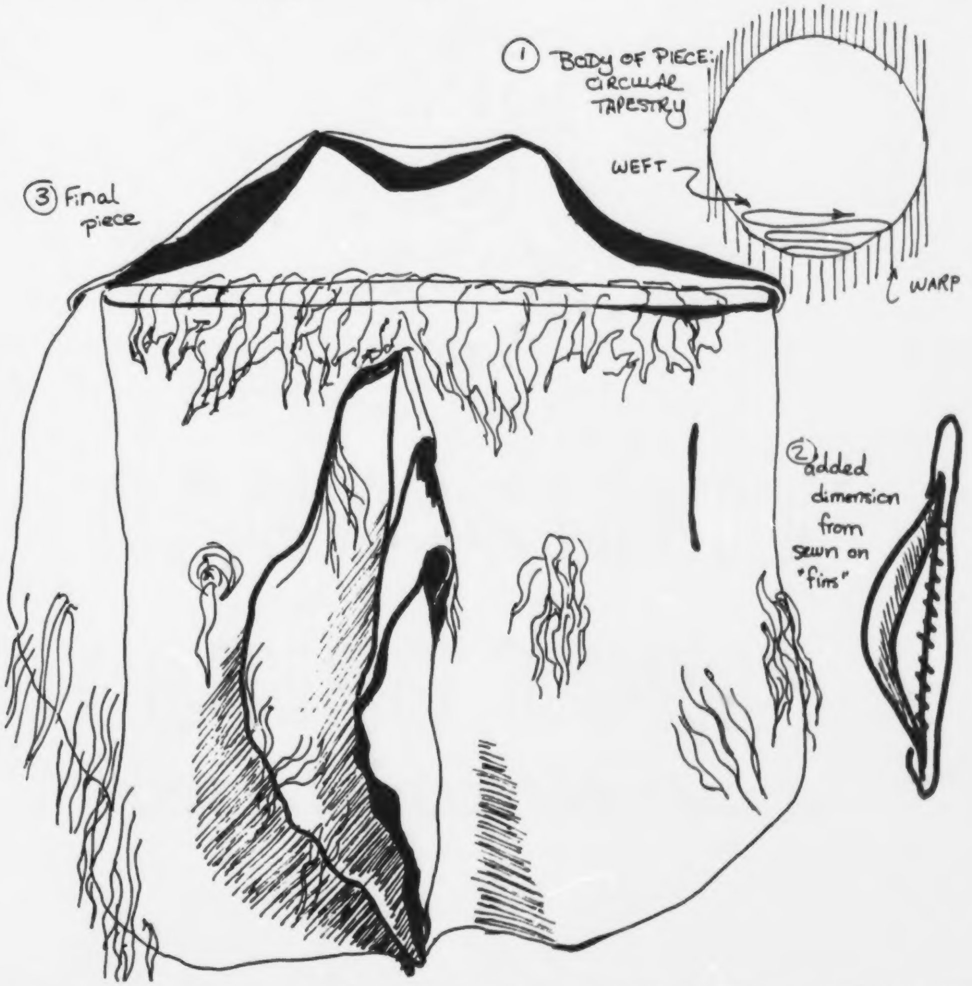
① BODY OF PIECE: CIRCULAR TAPESTRY
WEFT
WARP
③ Final piece
② added dimension from sewn on "fins"

Figure 4. Technical analysis of Magdelena Abakanowicz's *Abakan Rouge, 1969*, 13' x 13' x 11.5' adapted from Beyond craft: The art fabric by Constantine & Larsen, 1972, p.87 (Sketches by J.A. Renzi, 1995).

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Figure 5. Buic's large scale environmental tapestries (Taken from Beyond craft: The art fabric by Constantine & Larsen, 1972, p.124).

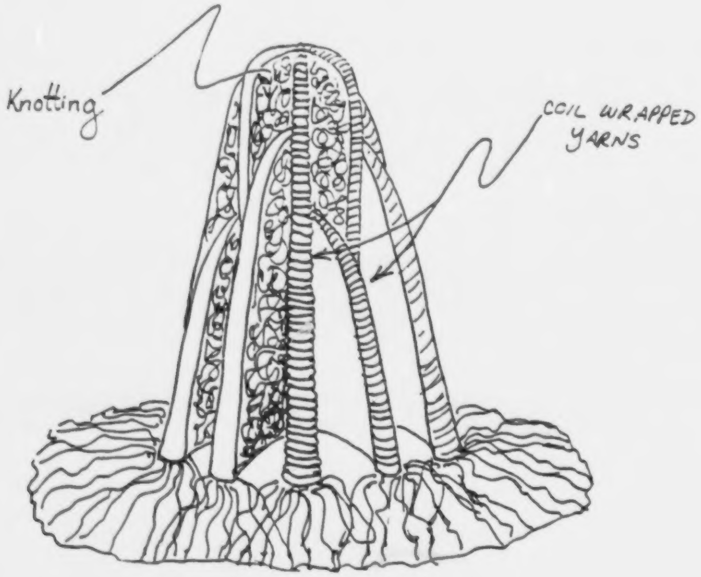


Figure 6. Diagram of a free standing textile form by Zeisler adapted from Textile sculptures by Waller, 1977, p.147 (Sketch by J.A. Renzi, 1995).

Abakanowicz, a tapestry weaver, began to develop her monumental piece three-dimensionally by utilizing supplementary warp techniques. Extending her works into space by developing off-loom weaving techniques led to the creation of her gigantic, organic, "cloak-like" (Hutton, 1975, p.90) textile forms. Buic also worked with tapestry techniques and although her weaving took a similar direction, as tactile installation works that the viewer could interact with, they remained wall-like and geometric in form . The three-dimensionality of Buic's work was also created off-loom, and through post loom construction (eg. sewing, thread removal, pulled warp, etc...), multi-dimensionality was achieved. Although not weaving, the fibreart of Claire Zeisler further extended textiles into space by eliminating the planar aspect of cloth and combining various interlacement techniques. Zeisler extended the actual materials into three-dimensional space through knotting and wrapping techniques that enhanced the form.

During the late nineteen-seventies/early eighties, art textiles began to flatten once more, emphasizing surface design or pictorial representation more than structure. There was a noticeable decrease in fibre art books published during this period, especially those dealing with textile sculptures, forms, and structures. Tapestry was glorified once more as the highest textile art form. Any attempt at three-dimensionality was limited to fabric relief that, instead of allowing the piece to be viewed in the round, remained hanging flat against the wall.

The late nineteen-eighties/early nineties, saw fibre art shifting off the wall and once more occupying three-dimensional space. However, this current three-dimensional fibre art trend has become a more gradual process. Tapestry imagery remains the textile art form of choice. Many of the woven fibre art publications currently available still emphasize this tapestry preference. Yet, the next generation of woven textile designers are beginning to concentrate on "linking process to content" (Schira, 1995, p.33) and creating complex weave structures by combining traditional techniques. The complex and lengthy process of handwoven multi-layered weaving may intimidate some weavers, but with the increase in computer technology, and the development of new textile resources, the task of creating innovative textile forms by hand has been made more technologically complex, yet more personally expressive and efficient.

Two-Dimensional vs Three-Dimensional Design

Three-dimensionality refers to the existence of an object in space through the characterization of length, breadth, depth, and multiple-perspective viewpoints. The differences between two-dimensional designers (eg. drawing, painting) and three-dimensional designers (eg. sculpture, ceramics) begin with the three-dimensional designer's ability to mentally visualize tangible objects and forms in space prior to their creation (Wong, pp. 6 & 7, 1977). This mental visualization is one of the processes which I utilized for this study.

I have observed that authors Colchester (1991), and Coatts (1992), refer to textile surface relief effects as three-dimensional textiles. This reference is a misnomer in relation to what I identify as three-dimensional textiles and may confuse the readers of this thesis. Due to the existence of such variant terminology, I decided to include a personal definition of three-dimensional weaving, along with three-dimensional design, in the glossary at the end of chapter two.

My three-dimensional textile design ideas begin on paper with two-dimensional spatial representations of three-dimensional forms. After many years of woven textile design production research, I have come to know the limitations and creative possibilities of handwoven design. For me, three-dimensionality is a structural component of woven textile production. Moreover, I have expanded my view of three-dimensional textile structures to that of encompassing space, becoming forms that can be viewed in the round. How the three-dimensional form will come to be proceeds from my intuitive analysis of the preliminary two-dimensional visualization.

2. ARTIST'S STATEMENT

There is a sensuousness in textiles that is not present in any other media. Cloth "responds" to air currents and touch through movement in the same way we respond to physical contact by breathing, caressing, or dancing. Textiles can be manipulated into whatever forms we desire. In contrast, textiles also impose their inherent qualities upon the user, controlling the manipulator, and thereby creating a symbiotic relationship. The fact that textiles are tactile as well as visual offers the individual varying emotional responses and intellectual stimuli. Using fibre as an extension of myself, I offer individuals new ways of seeing, new ways of existing in a sometimes cold, hard and static environment.

The creation of a textile is the extension of the artist's inner self. Through various combinations of threads as parts of a whole, a textile, in its development, begins to take on its own unique characteristics. These special characteristics are what distinguish the textiles created by individuals from those created by industry. The individual craftsperson/artist superimposes his or her ideological aesthetics into the body of the cloth, thus transforming the abstract idea into the concrete object. As the textile is created, the artist can alter the original design through hand manipulations. Industrially produced textiles lack this advantage.

As the creator, I let the textile communicate its characteristics by remaining true to the nature of the material. Through scientific study, I know how certain fibres behave. Through mathematical manipulation of the threads, I can structure the textile according to the behaviours of the fibres. Through artistic evaluation, I invent new possible directions that the structure of the weaving can take. All of these methods are negotiated by me, the designer/producer of the textile, while I am simultaneously being controlled by the textile. By combining these methods, I can influence and be influenced by the materials while creating a textile.

I view textiles as three-dimensional objects, not flat planes. Traditionally viewed as two-dimensional, textiles have become cocooned in cultural stigma and technological limitations. The three-dimensionality of the cloth is subtle and not immediately obvious to the everyday viewer since textiles are generally viewed as having only two sides. By exploding the structures within the structure of the fabric, an architectural, three-dimensionality can be achieved. I construct textiles with depth as well as height and width to fill an empty space in the outside world as well as within. I see handweaving as an innovative tool in the production of contemporary textiles. The hands-on approach in combination with the theoretical will successfully aid in the development of novel textile ideas for the future.

Objectives

The specific objectives of my research project were;

1) To create handwoven, three-dimensional textile forms on multi-harness floor looms and to document the process,

2) To explore the relationship between internal and external spatial compositions created during the presentation of woven three-dimensional textile forms in architecture.

Exploratory Directions

My primary focus in this study was to explore the diversity of structure and form in double-woven textile design. I have accomplished this through the investigation of woven planar exchanges on a multi-harness floor loom. As a textile is created, it exists as a horizontal flat plane. If more than one textile plane is woven simultaneously on the same loom, each individual plane can interchange vertically, horizontally, or fuse together to create an infinite number of fabric structures. Once removed from the loom, this structured textile can be manipulated into three-dimensional forms without the aid (or presence) of stitched seams. The shaped pieces are formed on the loom using the two existing warp and weft thread elements, thus eliminating the need for a third element, stitching thread, which is weaker than a continual, integrated, interlacement of weft threads.

I have produced three-dimensional textile forms through the exploration of historical and contemporary weaving techniques and structures. During this process I also applied architectural and sculptural design elements while taking textile conservation methods into consideration. The physical and chemical characteristics of the materials used in the textile structures were incorporated with my designs in order to achieve fabric forms that were structurally sound. Therefore, in using specific materials, such as ramie or cotton threads, I have also enhanced the longevity of each fibre-art piece through the application of conservation principles.

Textiles are usually perceived as either aesthetically or not so aesthetically pleasing to the senses, however; the production and exhibition of textiles can also be viewed as an intellectual process. Physics, mathematics, chemistry and biology are all factors in the forming and presentation of textile objects. As a holistic researcher I drew information and inspiration from all of these sources, creating new production and exhibition methods. During this study I have also discussed the possibility of combining preventive textile conservation factors and space structuring aesthetics (eg. art installation) to develop an alternative method of textile presentation. With this intuitive process of analysis, I can choose where and/or how to display my completed woven sculptures safely and effectively.

Significance of Study

My study has been grounded in human ecology. Westney, Brabble, & Edwards (1988) define human ecology as:

> the scientific and holistic study of human beings, their environments, and human-environmental interactions. As a discipline, human ecology is both a science and an art. As an applied discipline, it seeks to identify the forces which enhance human development, actualize human

> potential, optimize human functioning, and improve the human condition and the quality of the lives of people (p. 129).

I have taken a holistic approach to my study and focused on constructing and/or affecting people's near environments. This is possible through the installation of my fibre art within these environments. Bubolz & Sontag (1993) discuss human ecology in relation to humans and their environments as "inseparable parts of a greater whole"(p. 419). They summarize that one perspective of contemporary human ecology theory is a holistic and interdisciplinary approach, "building on the natural and social sciences and the arts and humanities/ recognizing[sic] that humans required material goods for living, as well as interactions with others, and that these needs were interdependent with the environment" (p.421).

We tend to adapt to our near environments using objects that are intrinsically suited to our individual aesthetic perceptions. For example the decision to buy a house or a condominium, paint a room red or yellow, or choose fabric to use for curtains, are all processes that affect the emotional and psychological well-being of individuals. According to Bubolz & Sontag (1993), "in an ecological perspective the quality of life of humans and the quality of the environment are interdependent. The well-being of individuals and families cannot be considered apart from the well-being of the whole ecosystem" (p.425). Thus, creating a person's near environment, complete with aesthetic objects, satisfies one objective of human ecology as outlined by Westney, Brabble, & Edwards, that is, "to delineate knowledge, policies, conditions and strategies for creating or enhancing environmental settings to increase the likelihood of optimal human development "(p.130). Therefore, this study contributes explicitly to the holistic fundamentals of human ecology and to the body of research in the field of woven textile design.

Textiles make up a large percentage of society's near environment providing shelter, warmth, comfort, communication, and visual stimulation. All of these factors play vital roles in the development of a healthy society. The complexities of western society also express the need for progress and technological advancement. Currently, there is an impasse between traditional handweaving techniques and industrial textile production. Research developing new solutions to traditional problems in handweaving plays a key role in determining the future of the textile industry.

Textile design, including traditional weaving, must develop with society's evolving technological future. This imminent new technology could fulfil the increasing demand for unique and original ideas in design. Because such originality needs to come from the artistic/creative self, the designer searches for self-expression in new processes and ideas. Three-dimensional textile designs as related by Emerson (1969), and Mohammed (1990), are confined to industrial, aeronautic, and national defence applications. This limits the techniques and uses of three-dimensional textiles being developed. By restricting these forms to static composites, industry has not been exploring the possibilities of newer, more creative developments through social, domestic, and artistic three-dimensional textile uses. However, W.C. Smith (1995) recently published a brief article discussing the new industrial textile advances at Techtextil, the biennial international showcase for technical textiles in Frankfurt, Germany. Smith recounts a "new process" that the German company, *Shape 3 Innovative Textiltechnik* introduced using "special shaping devices on a conventional loom" (p.70). These three-dimensional "shapes" were described by Smith as "most practical" especially when the company wishes to manufacture special three-dimensional forms, an act that is "not feasible or too expensive or results in undesirable seams or inadequate properties", when creating these forms from two dimensional fabrics. Shape 3, along with Hoechst's new "double-layer, three-dimensional textile structures" (p.69), are the first industrial textile companies to acknowledge the vast possibilities of woven, three-dimensional, multi-layered forms suggesting clothing production, in addition to their use in special composites, as a typical application of these structures.

Three-dimensional fibre artists such as Magdalena Abakanowicz, Kay Sekimachi (see Figures 4 & 2 respectively), and Paul R. O'Connor, creator of free-standing, double woven forms (see Figure 7), have explored some possibilities of three-dimensional tapestry and double weave, creating sculptural forms from flat-woven textiles. Of their explorations, some sculptural possibilities of fibre characteristics combined with structural variations in the weaves were suggested, but many more were not utilized or fully documented. Brostoff (1977) supports this need to experiment by saying, "The use of double weave has, on the whole, been limited to double width cloth, tubes, small traditional patterning for pillows, coverlets, striped carrying bags, and multi-layered tapestries" (p.5). Constantine and Larsen (1981), further support this position relating, "Potentials for crisp delineation, systemic color-play, and positive-negative surprises within one cloth face (or from one face to the other) have been explored but not exhausted" (p.179). I have examined the works of various three-dimensional fibre artists, investigated other sculptural possibilities, then applied and documented the outcome in this thesis, producing a personalized body of work.

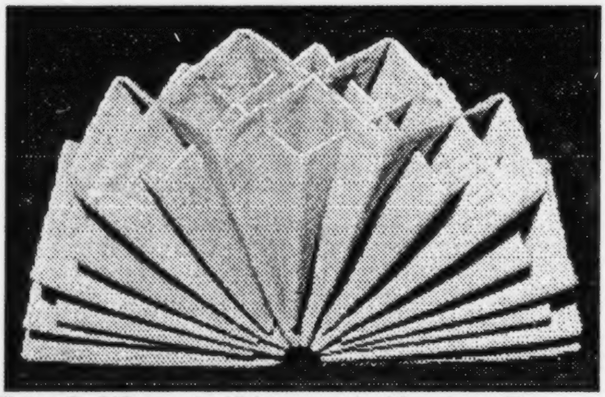


Figure 7. O'Connor's 16-harness double woven *Fan, 1987*, (O'Connor, 1992, p.58). Reprinted with permission.

It is difficult to explore weaving techniques that free the textile artist to work three-dimensionally since written documentation of the design processes, technical data, and artists' concerns, has not been a common practice among fibre artists of the last few decades. This study has taken these issues into account by visually and textually documenting the process of creating handwoven, three-dimensional textile forms. Furthermore, I also addressed the issue of artists taking the longevity of fragile or perishable art pieces into account when turning their creative ideas into completed works.

There is very little published material available on the process of creating handwoven artworks. Recent studies by Maguire (1995), Bakgaard (1995), Ciao (1993), Weir (1993) discuss creativity in textile design, however; they do not specifically deal with handweaving. My study, which is relevant to fibre artists and textile scholars, is a contribution to current textile production literature. This investigation is both scientific and artistic; these are two important descriptors used in Westney, Brabble, & Edwards' definition of human ecology. By having taken a holistic approach, I have considered human-environmental interaction as a significant aspect of my work. The textual component of my thesis addressed the issues of utilizing holistic methodologies, documenting my design process, technical information, and textile conservation methods. The visual component of my thesis approached the use of visual data as primary bibliographical reference material, and presented my three-dimensional textile sculptures as the encapsulation of negative space balanced with positive forms within space. It is my ambition that this study will aid in the evolution of textile design and human ecology research, and provide a model for further studies in the creation of contemporary textile designs.

Materials & Equipment

The materials an artist chooses to work with are not necessarily limited to those of preference but also to availability, cost, health restrictions, and cultural applications. Personally, I am unable work with the most affordable and readily available textile material - wool, due to allergic reactions. Therefore, I have chosen natural cellulosic fibres: ramie, cotton, and linen, that are conducive not only to overcoming health problems but also to textile conservation. The conservation characteristics of these fibres, particularly ramie, are discussed later in this study.

As a creator of textiles using complex weaving techniques, I prefer to explore technical possibilities through the use of multi-harness floor looms. The greater the number of harnesses, the greater the possibilities. My three-dimensional designs were based on eight harness floor loom capabilities with the possibility of expanding to twelve and sixteen harnesses. Various weaving tools such as shuttles, bobbins, reeds, reed hooks, bobbin winders, etc... were utilized in the production of my woven sculptures.

Traditional weaving technologies were used in conjunction with modern technologies in order to generate technical drafts needed in woven textile production. The economic and efficiency benefits that computer aided design offers weavers, allowed me to spend more time creating textiles instead of wasting hours planning them. Prior to computer aided weave design (CAWD), all drafting was accomplished by hand on graph paper and took weeks to complete. With computer aided weave drafts, I can quickly sketch my design, draft a basic weave structure, plot out the threading and treadling, and immediately begin to wind and warp a weaving project all within a few days.

One drawback to the two-dimensional CAWD programs, is that they have limited applications to multi-layered weaving. Therefore, my procedure began with a basic computer double-weave draft (see Figure 8), which allowed me to plot the threading and treadle tie-ups and develop varying multiple weave structures during the weaving process. Next, the warp to be woven was wound according to the basic prescribed design. During the handweaving process I allowed the media to guide the eventual design. Handweaving has remained as the technique of choice for my three-dimensional forms as hand manipulations of the warp and weft threads have allowed for spontaneity and achieved difficult weave structures that are not yet possible to create industrially. Once a piece is created, I completed the documentation of the design process by drafting the completed design.

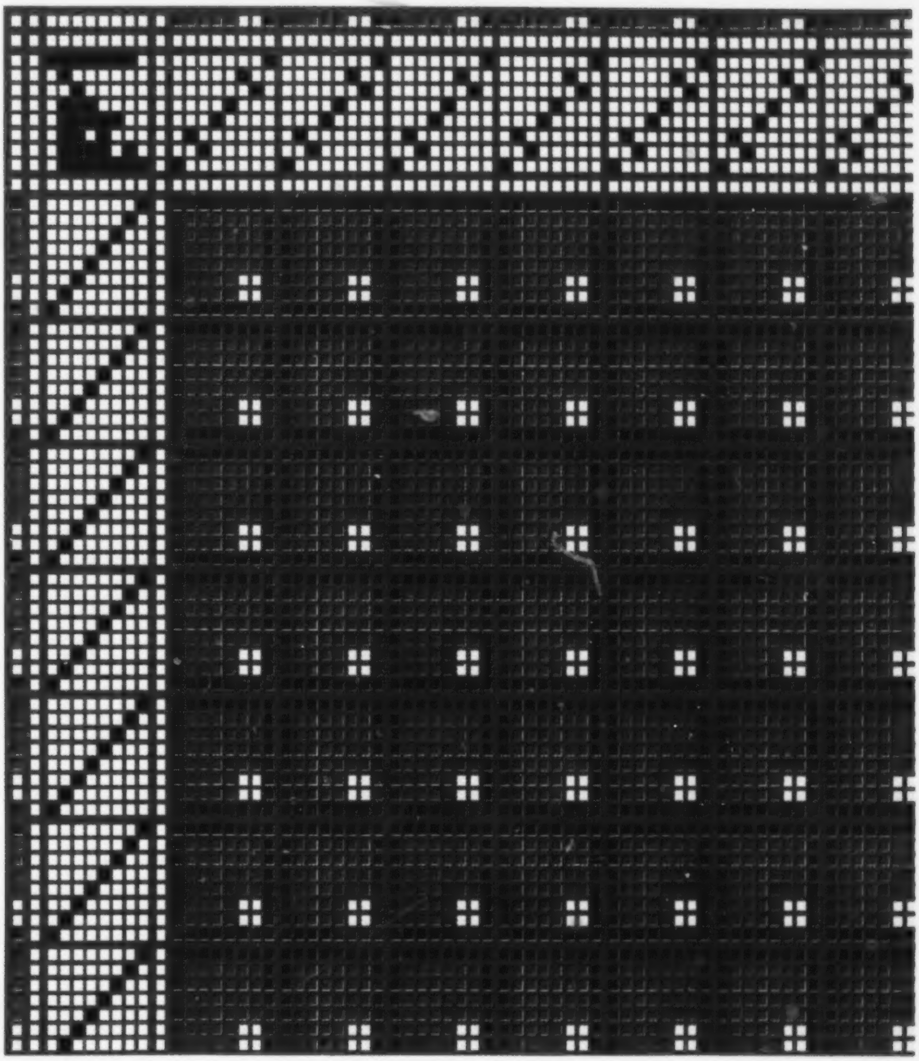


Figure 8. Computer weave draft of a basic quadruple weave, or "four layer" weave, utilizing eight harnesses (Drafted by J.A. Renzi from Patternland Weave Publisher 2.1 [Computer software], 1991, Plainfield, Vermont :Maple Hill Software).

Limitations

As there is no limit to the human imagination, limits were only set for the following components of my study:

1) Weaving materials have been restricted to cellulosic plant fibres such as ramie, linen, and cotton. These have proven to be the best choices meeting concerns addressed in this thesis; the fibres' physical traits, hypoallergenic properties, and the conservation of the finished textiles.

2) Equipment used consists of the IBM computer, the Patternland Weave Publisher 2.1 computer aided weave design program, HP 540 Paintjet colour printer, and 16,& 8-harness floor looms.

3) The size of the finished pieces did not exceed 1-2 meters in height. The number of textile pieces produced depended on the amount of production time for each; three smaller and two larger pieces were produced.

Glossary

The following terms were used within the body of this thesis;

Beater: a frame which holds the reed and is used in weaving to beat the weft (Hjert & Von Rosenstiel, p.158).

Bobbin: a spool-like device upon which weft thread is wound for use in a shuttle in weaving. The bobbin sets in the shuttle and carries the thread across the loom (Dan River, p.14).

Double-Weave: a weave that produces two textiles simultaneously, one above the other. The warp is composed of two series of ends, and each interlaces with its own weft or with a common weft which works with each series in turn. The binding of each textile is usually the same, most commonly tabby (plain weave), but other and different bindings may also be used. In patterned double weave, the two textiles change position as required by the pattern. Triple or multiple layered weaves are based on the same principle as double weave (Burnham, p.197).

EPD (Ends Per Dent): the number of warp ends threaded in each reed dent depending upon the size of the thread.

EPI (Ends Per Inch): the number of warp threads (or ends) needed to create a textile of a certain width depending upon the size of the threads.

Handwoven: fabrics which are woven on either the hand or hand-and-foot power loom (Dan River, p.47).

Handwoven Textile Artist: a textile artist who creates fibre art on hand and foot powered looms, executing complex weave structures that are not possible on an industrial power loom. This type of textile artist creates one of a kind art works.

Harnesses: the frames on a loom behind the beater which hold the heddles (Hjert & Von Rosenstiel, p.158).

Heddles: wire or nylon strings with an eye in the centre. Heddles are held by the different harnesses. The order in which the warp is threaded through the heddles determines the pattern of the weave (Hjert & Von Rosenstiel, p.158).

Industrially Produced Textile Artist: a textile artist who creates complex weave designs that can be created using industrial power looms. This type of textile artist creates textile designs that can be produced in multiples.

Lams: horizontal members used as an intermediate tie-up between the treadles and the harnesses of a floor loom (Hjert & Von Rosenstiel, p.158)

Multi-layered Weave: the simultaneous creation of three or more separate cloths on the loom. These multiple cloths or "layers" can be kept separate or combined using various weave structures and techniques.

Reed: a metal frame with slits or dents housed in the beater frame. The reed is used to evenly space the warp threads and to beat the weft in weaving (Hjert & Von Rosenstiel, p.158).

Plain Weave: the basic structure in cloth production created by each weft unit passing alternatively over and under successive warp units. If the warp and weft elements are equally spaced and either identical or approximately equal in size and flexibility, the plain weave can be described as balanced (Emery, p.76).

Processual (Study): an adjective describing the exploration of the processes involved in, eg. the production of woven art forms.

Shed: a temporary opening between two planes of warp threads selectively separated for passage of the weft (Emery, p.75).

Shuttle: the boat-like device which carries the weft threads wound on the bobbin which sets in the shuttle (Dan River, p.95).

Sley: to thread the warp threads through the reed dents; the number of warp yarns or ends per inch.

Tensile Strength: the maximum load per unit of the original cross-section area obtained prior to rupture. It is the actual number of pounds resistance that a fabric will give to a breaking machine before the material is broken on the testing apparatus and may no longer be classed as a cloth or fabric (Dan River, p.106).

Threading: the order in which the warp threads are threaded through the heddles.

Tie-up: the linking or tying up of the lams to the treadles of a floor loom; the possible combinations of harnesses used in weaving (Hjert & Von Rosenstiel, p.158).

Treadles: pedals located at the base of the loom attached to the harnesses that when pressed, lift the warp threads in a certain order, as required by the weave design.

Two-dimensional Design: the creation of a two-dimensional world with conscious efforts of organization of the various elements. Casual marking such as doodling on a flat surface may have chaotic results. This may be far from two-dimensional design, the main objective of which is to establish visual harmony and order, or to generate purposeful visual excitement (Wong, p. 6).

Three-dimensional Design: is concerned with the three-dimensional world. It is more complicated than two-dimensional design because various views must be considered simultaneously from different angles, and much of the complex spacial relationships cannot be easily visualized on paper. Yet it is less complicated than two-dimensional design because it deals with tangible forms and materials in actual space, so that all the problems involving illusory representation of three-dimensional forms on paper (or any kind of flat surface)can be avoided (Wong, p.6).

Two-dimensional Weaving: to create a flat textile that, once cut from a loom frame, remains flat revealing two sides; either back and front or, in the case of a double weave, reversible.

Three-dimensional Weaving: to create a flat textile that, once cut from a loom frame, opens up to reveal two or more intersecting layers which can be viewed in the round.

Warp: essentially parallel elements that run longitudinally in a loom or fabric, crossed at more or less right angles and interworked by transverse elements (Emery, p.74).

Weft: the transverse elements in a fabric (generally parallel to each other and to the terminal edges or ends of the fabric) which cross and interwork with the warp elements at more or less right angles (Emery, p.74).

3. WOVEN TEXTILE DESIGN METHODS

Thesis Metaphor

My design process is one that is unconscious and intuitive. Trying to relate consistently and intently one specific format to my creative process is an exercise in futility, as this process is always in constant flux. In contrast, the traditional process of handweaving is very methodological. For the purposes of this study, I have described the process as it relates to the technical development of my handwoven, three-dimensional, textile forms.

The process of constructing the visual component of my thesis has become the metaphor for the written component. Like the crossing of warp and weft threads in a multi-layered weaving combining to form a cloth, the "threads" of thought used in the creation of my visual work and written thesis form a "cloth" of alternating physical structures and theories. In order to create the "cloth", I need a draft. My draft = my proposal + my process + my product + my innovative methods of reifying my experiential knowledge (see Figure 9).

For example, the theoretical components of my thesis, or the "stable elements", are represented by the warp threads which run vertically. The physical components, or the more "variable elements", are represented by the weft threads which run horizontally. The theoretical components are; architecture (includes space, three-dimensionality, & composition theory), conservation, weaving design, historical applications, and technical analysis. The physical components are; exploratory research (library and internal), designing, weaving, post loom manipulation & composition (includes finishing, embellishment, & proto-structuralization), installation, and object longevity.

During the creative process, one or more of these elemental layers may intersect, or combine with, one another. The final body of work, or "cloth", will depend upon the location, amount, and method of construction of the merging elements. The patchwork section of the diagram is an abstract visual representation of the multi-dimensional structures that can be obtained when combining the theoretical and physical components of my thesis.

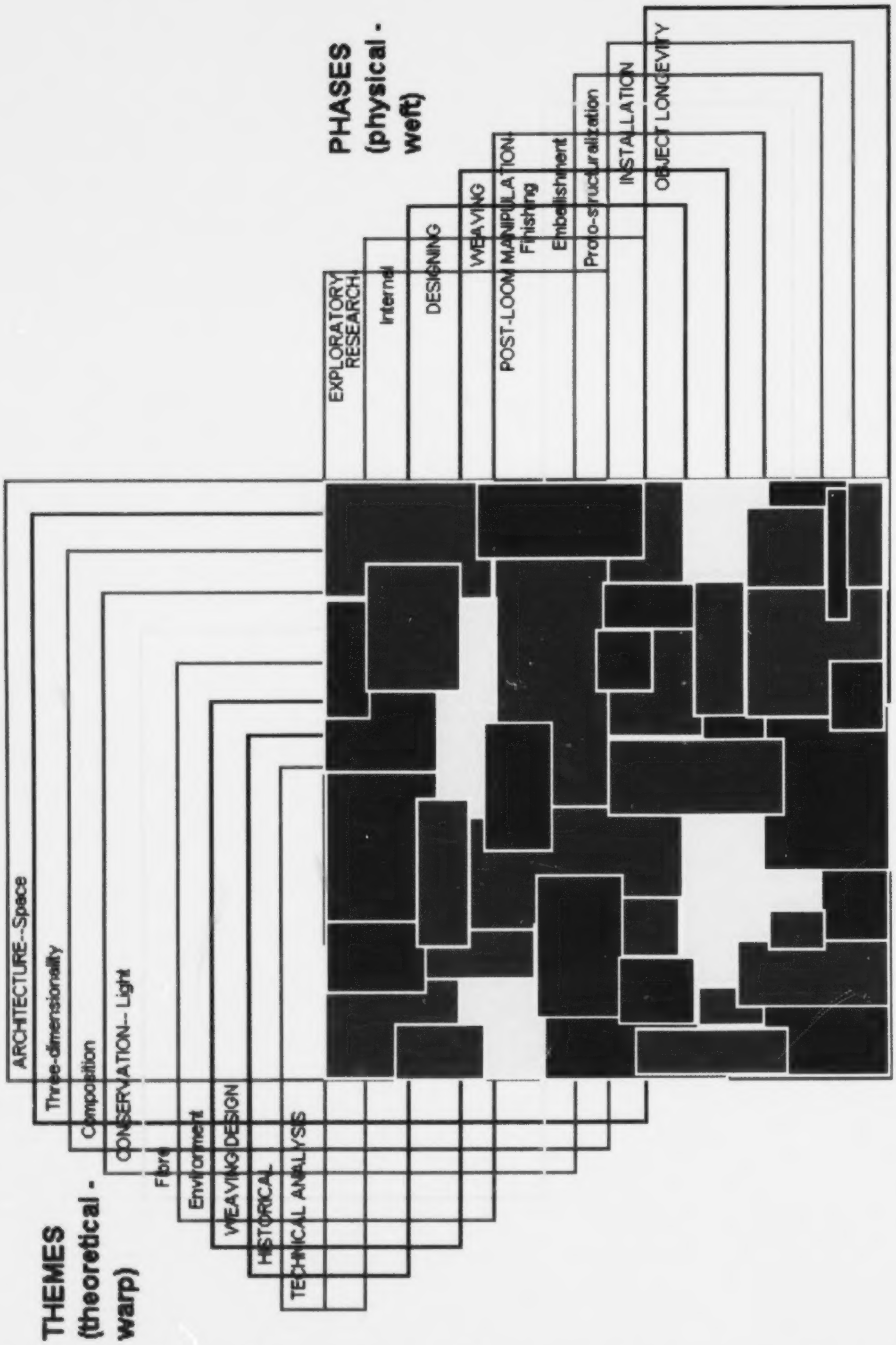

PHASES (physical - weft)
EXPLORATORY RESEARCH
Internal
DESIGNING
WEAVING
POST-LOOM MANIPULATION
Finishing
Embellishment
Proto-structuralization
INSTALLATION
OBJECT LONGEVITY
THEMES (theoretical - warp)
ARCHITECTURE--Space
Three-dimensionality
Composition
CONSERVATION-- Light
Fibre
Environment
WEAVING DESIGN
HISTORICAL
TECHNICAL ANALYSIS

Figure 9. Thesis metaphor: illustrates intersection of theoretical warp and physical weft thread layers. (Drawn by J.A. Renzi from Microsoft Windows Paintbrush [Computer Software], 1993).

Theoretical Framework

> "Those who are enamoured of practice without science are like a pilot who goes into a ship without rudder or compass and never has any certainty where he is going. Practice should always be based upon a sound knowledge of theory" (Leonardo da Vinci in E. MacCurdy (Trans.), 1955, The notebooks of Leonardo da Vinci, (Vol II), p. 283).

According to Leonardo da Vinci the only way to create a work of art was to fully understand the factors involved in the existence of the subject as well as the techniques involved in the subject's rendition. Leonardo was a painter, engineer, architect, draftsman, anatomist and botanist. He was able to practice several arts through his mastery of various theories and techniques. It is this holistic attitude towards balancing the theories of science and art that I adopt in my study.

In a holistic way, contemporary textile designer Junichi Arai, has successfully achieved a balance between innovative, industrial textile design and artistic expression. Through the combination of computer-aided and traditional textile design and production, Arai can transform his abstract artistic ideas into concrete, original textile pieces (see figs. 10, 11, & 12).

Figure 10 was removed due to copyright restrictions.

Figure 10. An industrial surface dying technique forms this structure entitled *Cobalt* (Hand and Technology: Textile by Junichi Arai [Catalog], 1992, Plate 11, Japan: Arai Creation System).

Figure 11 was removed due to copyright restrictions.

Figure 11. Dyed and formed textile by Arai entitled *Phenocryst* (Hand and Technology: Textile by Junichi Arai [Catalog], 1992, Plate17).

Figure 12 was removed due to copyright restrictions.

Figure 12. Arai's raschel knit, spider-web fabric (The new textiles by Colchester, 1991, p.70).

Arai's view of textile design is one of futuristic progression that is not hampered by tradition, "We cannot fulfil the needs of people today by mere nostalgia. We must understand the desires of the modern spirit so that we can create a truly appropriate contemporary fabric"(p.9). Tradition is not ignored, however, but incorporated into the designs by incorporating the skills of traditional weavers in the industrially-based production of his textiles, "in fact, he admits trying to create new textiles that embody the soul of fabrics made by primitive peoples" (Fielder, p. 14).

In order for textiles to develop in a positive and innovative way, the attitudes of some textile designers and producers need to be adjusted. According to Arai, "When things are made which look only backwards, to the supposedly golden past, they are the products of the nostalgia of weak people" (Sutton & Sheehan, p. 8). To many craftspeople, technology is seen as a monster coming to devour the traditional and human aspects of cultural activities such as weaving (i.e. technological determinism). Yet, if this "monster" is approached head on and tamed, it can work with the designer to his or her advantage. This approach can only be achieved through understanding of the techniques, mechanisms, and structures that form the basis of weaving technology. Once these are understood, like the characteristics of the fibres that make up the cloth, the characteristics of the technological can be incorporated with the traditional to create innovative textiles that have aesthetic properties.

I incorporated the theoretical frameworks of daVinci, and Arai with my own personal theories when conducting my research. I saw the cooperation of the individual, traditional, and technological as a future methodology in textile production. The individual perspective can soften the hard edge of modern technology, while modern technology can aid in the development of unexplored attributes of innovative ideas. The collection of these new, holistic components of textile design could provide artist/designers with the information needed to express themselves more effectively.

Innovative Methods of Reifying Experiential Knowledge

Artistic methodology is rarely documented or understood. Very few artists have kept journals or approached the subject of methodology about their own work. Even fewer journals and recorded methods exist by fibre artists. An excerpt from Leonardo da Vinci's notebook includes his method of stimulating and arousing the mind to various inventions;

> " if you look at any stone walls spotted with various stains or with a mixture of different kinds of stones, if you are about to invent some scene you will be able to see in it a resemblance to various different landscapes adorned with mountains, rivers, rocks, trees, plains, wide valleys and various groups of hills. You will also be able to see divers combats and figures in quick movement, and strange expressions of faces, and outlandish costumes, and an infinite number of things which you can then reduce into separate and well-conceived forms. With such walls and blends of different stones it comes about as it does with the sound of bells, in whose clanging you may discover every name and word that you can imagine." (Leonardo da Vinci in E. MacCurdy (Trans.), 1955, The notebooks of Leonardo da Vinci, (Vol II), p. 250)

In this paragraph da Vinci explored the method of how one can be inspired from subliminal linear images occurring in various textural surfaces. Leonardo described a natural method where he superimposed his existing knowledge onto his experiential knowledge and reified it in order to create new ideas and theories.

Holistic Research:

Artist Observations

During the process of observation, the artist tries to see the interrelatedness of numerous disparate things so that criteria can be established as to specific design objectives. This is not an easily achieved element in the design process. To the artist, methodology implies structure, which immediately creates a barrier to any concept of free thought.

By taking a holistic approach and incorporating various research methodologies such as design, historical and technical analysis, I have developed an innovative method of reifying experiential knowledge and personal interpretation allowing for freedom of creation. The combination of aesthetic qualities and technological information of visual data aided me in the development of innovative woven textile research methods.

During the production of my thesis works, I referred to quotes of observations and images of pieces made by other double weave artists and throughout the duration of my thesis works I kept a journal of my own experiences. My journal, quoted in Chapter 5, may give other researchers insight into my creative process, and offer possible solutions to problems they may encounter. These journal entries also provide the various methods I used, presenting the readers with the holistic manner in which I work.

Visualization Process

For my thesis I documented the exploratory process as it unfolded in my attempt to move from two-dimensionality to three-dimensionality. This is a difficult exercise as the three-dimensional design process begins on paper as two-dimensional visual images. McKim (1980) has developed various psychological theories to explain the mysterious thought processes of the artistic mind. McKim described one problem solving or exploratory process as the visualization process, where the artist draws a series of brainstorming sketches or doodles on the same sheet of paper in order to visually develop design ideas. By keeping the sketches on the same sheet of paper, I can view the multiple phases of my personal visualization process (See Chapter 5). These sketches were included in Appendix A so that the reader could understand my visualization process.

Other authors such as Arnheim (1969) and Dondis (1973) also discuss their ideas of the creative process as it pertains to design and offer explanatory diagrams, however; for this study I concentrated on design methods specific to woven textile design development that have been suggested by Paque (1973), Albers (1965), O'Connor (1992), and Sutton & Sheehan (1988).

Creative Methodological Developments through Weave Design

During this study creative methodologies developed by allowing the handweaving process to determine the eventual outcome of my pieces. The design process and the materials involved encouraged a spontaneous evolution of ideas, and dictated the form of the finished piece. In other words the process and structures of handweaving, and the tools involved, governed the decisions I made during the production of my three-dimensional forms. By applying my technical and artistic knowledge, while simultaneously designing a form on the loom, new creative ideas evolved.

Joan Michaels Paque (1973) openly praised the application of holistic research to art and design of all forms. Paque referred to designers, or holistic researchers, as becoming comprehensivists or "eclectic pursuers of all knowledge, in order to realize this correlation that exists between all disciplines"(p. 3). This type of research, stated Paque, enables the designer to increase their knowledge through existing knowledge. For my thesis inquiry, I mentally explored the knowledge that I already possess and incorporated newly acquired knowledge while allowing "the creative concept to transcend the technical process". By combining the diverse research methods and technologies from many extant disciplines, infinite possibilities during the development of my design methodology emerged.

The Bauhaus weaver Anni Albers (1965) explored the process of textile design holistically by breaking down the various steps involved in realizing a work of art. By going into detail of how a textile is created, Albers summarized that diverse design attributes go into the research and development of a textile. To illustrate, depending upon the final function of the object to be created, many choices concerning raw materials, colours, form, location, weave structure, symbolism, texture and environmental effects, have to be made before attempting a new project.

Describing every designer, artist, or scientist as an amateur, one creating something new, that did not exist before, Albers explained the design process as an approach to a new, untried adventure. The creator must be able to "forego his own identity in order to be able more impartially to interpret the potential" (p.73). In other words, the designer must be able to allow that which is known not to overpower the unknown and vice versa, constantly changing any previous understanding.

Double weaver Paul R. O'Connor (1992) specifically wrote about the advanced aspects of loom-controlled double-weave. Through the examination and presentation of double-weave techniques by himself and other artists including painters and complex weavers, O'Connor (see Figure 13) extends the dimensional design possibilities of handwoven cloth. O'Connor developed and published his own notation technique, one that is easy to comprehend yet complex in its purpose, extending weave design theory beyond the traditional.

However, O'Connor's three-dimensional forms are limited in their applications. O'Connor worked mostly with interchanging warp techniques and stuffed double-layers, creating stiff, completely geometric forms. With the various multi-layered structures that could be created by combining interchanging weft and warp techniques, O'Connor's pieces, although complex in construction, remain static. My methodology includes a schematic organization developed by O'Connor, of the possible multi-layered weave structures that can be created on eight to sixteen harness looms (see Appendix C).

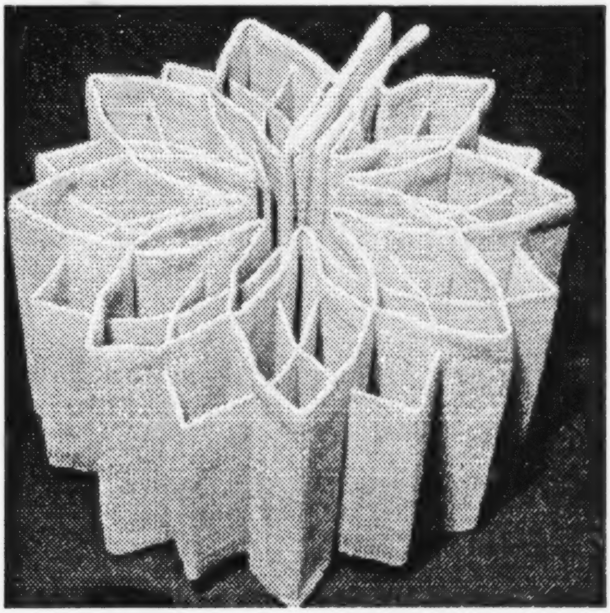


Figure 13. O'Connor's *Fan arranged as flower, 1987* (O'Connor 1992, p.71). Reprinted with permission.

Holistically, O'Connor's approach to weaving design is successful because it incorporates experiential knowledge of various cultures, fine art, and craft technologies into his design methodology. O'Connor spoke of the kinetic artist, Yaakov Agam's shaped canvasses with their ever-changing imagery as influential in his development of multi-dimensional textile forms (p. v). The influence of other double weavers such as Kay Sekimachi, and Ted Hallman were also presented along with technical analyses of their works.

In their book Ideas in Weaving, Sutton & Sheehan (1988) presented knowledge of the woven textile design process as a holistic culmination of knowledge of historical, contemporary, industrial, and primitive processes. The authors discussed creativity, thinking, and planning and how these actions affect the weaving design process. Although it is often neglected, the authors regard this process as the most important in cloth production, "Weavers tend to see themselves as doers, and indeed much time is needed to do weaving - but much time is wasted as well" (Sutton & Sheehan, p.7). Time is wasted during the creative process when the weaver desires to create something that had not existed previously.

Sutton & Sheehan (1988) stressed the importance of the generation of knowledge about inventive ideas in weaving. By breaking barriers such as those existing between the strange and the familiar, order and chaos, accidental mistakes and planned perfection, weavers can expand their creativity and inventiveness. The authors encouraged weave designers to break these barriers at every stage of the weaving process and even aided in the development of that process. Four distinct stages in creative thinking were presented: preparation, incubation, visualization, and evaluation. According to the authors, these remain the same for every creative project.

Historical Textile Design Research

The craft of weaving has a tradition that extends back to 3000 BC (Rowe, 1977). With a technical history that extends that far back in time, it would be impossible to ignore it's influence when creating contemporary textiles. According to my design process, the historical research I conducted aided in my idea generation of technologically advanced textile designs. This study included historical research using primary data collected from artifacts housed in the Clothing and Textiles Study Collection of the Department of Human Ecology at the University of Alberta. Primary data includes textile technical analyses, drafts, and photographic documentation. Secondary data includes examples of literature that utilized various historical textile research methods.

Technical Analysis of Production Techniques

Through technical analysis I have constantly evaluated the development of my textile designs. I kept a tabulation of thread ends per inch as well as warp length. The mathematical basis of weaving demands I draft my designs before commencing a project. Yet, once that project is under way and I discover a new procedure during the production of a woven textile, I may have chosen to incorporate that procedure into my research. In this way, I have kept an open design concept for my end product. Also following this concept, I have designed various possibilities in three-dimensional form for each piece. In this way, I have allowed for adaptation of form depending on the location and installation of my pieces.

The documentation of my woven textile designs were recorded with the aid of the computer. Computers play an integral role in today's society. Efficient and economical, computers are able to produce simulations of textile designs and operate looms. Designs developed for this study were generated and stored on an IBM computer using the Patternland Weave Publisher 2.0 program. This computer program has complex drafting and easy edit capabilities which were beneficial in my design developments (see Appendix B).

The process of handweaving allows intricate manipulations that are not otherwise possible in automated textile production. The weaver has the opportunity, while weaving, to change the weave structure, control tensions, and to perform weaves that can only be obtained by hand. I decided to develop three-dimensional weaving techniques on a multi-harness floor loom. This development was achieved through experimentation with multiple-layered weaves and self-developed techniques. ('Self-developed' being combinations of various traditional weave techniques).

Through a review of visual as well as literary influences, I was able to create a basis for the production of original fibre art pieces. By combining various existing methods with new methods of data collection and interpretation to obtain innovative weaving techniques, I have produced three-dimensional textile forms for the outer and inner environments we all share.

Visual Data as a Primary Bibliographical Reference

It is crucial to my research to use pictorial representation in the place of literature when the data being collected for research are photographs of an object or a technique. The visual as information is the basis for this method. The use of visual information is a valuable tool for any research that is design or visually based. R. Pettersson (1989), describes different kinds of information systems and how they all interrelate through the use of visual information. Pettersson states, "A visual is more pertinent reference for meaning than the spoken or written word. Visuals are iconic. They normally resemble the thing they represent"(p. 4). He then goes on to explain how the viewer perceives visual information, the need for understanding through visual data and the functions of pictorial representations as information.

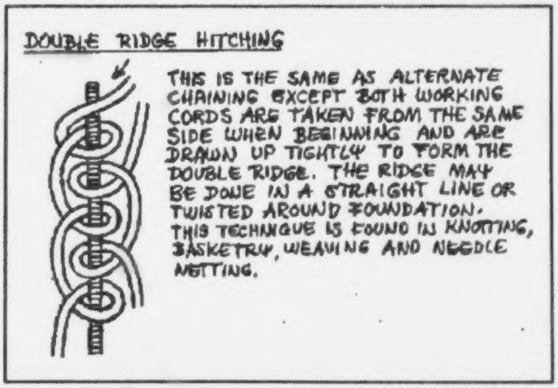
Dondis (1973), remarks, "seeing is a direct experience and the use of visual data to report information is the closest we can get to the true nature of reality" (p. 2). Dondis separates visuals into three "distinctive and individual" levels in order to get a better understanding of how visuals can be interpreted. These three levels are;

1)the visual input, which consists of myriad symbol systems,
2)the representational visual material we recognize in the environment,
and, 3)the abstract understructure, the form of everything we see.

These three levels become important when trying to compose visual material for communication. But, this study not only concentrated on the ways of creating but also the ways of utilizing existing visual information.

There is a vast amount of information that can be obtained from visual data. Whether instructional, presentational, or explanatory, various visual messages are divulged. The way these messages are perceived and interpreted, is a form of visual or pictorial content analysis. By employing this method of explication, visual data can be utilized as reference material in the literature review of a research paper.

Joan Michaels Paque (1973), in the Preface of her research of fibre techniques states, "I have come to the conclusion that most of the ills of the world emanate from our inability to communicate well because of the innate limitations of the written and spoken word. A great deal of my frustrations, in research and in learning, I attribute to this. As a result, my methods have evolved to be mostly visual" (p.3). Her research (see Figure 14) is a perfect example of how visual data can be successfully applied to convey textile research.



DOUBLE RIDGE HITCHING

THIS IS THE SAME AS ALTERNATE CHAINING EXCEPT BOTH WORKING CORDS ARE TAKEN FROM THE SAME SIDE WHEN BEGINNING AND ARE DRAWN UP TIGHTLY TO FORM THE DOUBLE RIDGE. THE RIDGE MAY BE DONE IN A STRAIGHT LINE OR TWISTED AROUND FOUNDATION. THIS TECHNIQUE IS FOUND IN KNOTTING, BASKETRY, WEAVING AND NEEDLE NETTING.

Figure 14. Paque illustration of knotting technique (Paque, 1972, p.11). Reprinted with permission.

The majority of the data that I have collected for my research are pictorial representations of fibre art. Most of the work that has been done on the subject of three-dimensional textiles has been in the form of actual pieces without written text accompanying them. What has been documented sometimes is the artist's or designer's statement, which is often a general philosophical interpretation of their work or brief technical data. This personal written viewpoint and the visual imagery of the art piece, both aid in the understanding of the descriptive process and conceptual framework of an art object. However, when the technical aspects of the work are under investigation, the visual information is more practical. By approaching the art work as a 'literary' resource, and the artist/designer as the 'author', the use of visual data can become a whole new textile research method.

4. VISUAL AND LITERARY INFLUENCES

Potter (1980), states that not only in textiles, but also in other fields of design where the decisions are "open and unconstrained" (p.66), it is necessary for the designer to share some framework with other specialists.

> "Nobody starts from nowhere; in which case it is better to determine your sources of inspiration, to go after them, and to try to understand what they are about. Otherwise a designer's vision is simply being programmed by the surface of the face of things' ".

In the following chapter I have outlined my sources of inspiration with regards to architectural theory, three-dimensional forms, weaving technology, and fibres. This chapter discusses the literature and visual references which have influenced the development of this research. It is necessary to include the visual examination, along with my own journal interpretations, of actual art objects along with literary sources in a study such as this, in order to fully explain certain visual theories and technical aspects. Even though literature is available on contemporary textile forms from 1960 - 1980, there is a noticeable absence of current literature (within the last 15 years) regarding the subject of three-dimensional, woven, textile forms. Therefore, I have broadened my research to include literature on and personal experiences with architectural, sculptural and natural three-dimensional forms.

Spatial Design Elements

> "It is in space that life and culture, spiritual interest and social responsibility, meet. For space is not merely a cavity, or void, or "negation of solidity"; it is alive and positive. It is not merely a visual fact; it is in every sense, and especially in a human and integrated sense, a reality which we live" (Zevi, 1957, p.242).

Kranz and Fisher (1976) describe three-dimensional forms, such as some architecture and other forms that incorporate space into the design, as "penetrated mass" (p. 100). In forms of this type (i.e. window within a building), mass and space intertwine and "become inseparable companions" (p.100). They then go on to describe other architectural and textile forms that suggest space in the design as "planar forms" (p.110), where mass is reduced to a series of interlocking planes that structure but do not enclose allowing the viewer to sense the presence of space in the shapes of planar forms such as leaves on trees. As textiles are intrinsically both two-dimensional and three-dimensional at the same time, both theoretical analyses of architectural forms posed by the authors can be applied to my handwoven, multi-layered forms

Architecture:

Structural form

Textile design, like architecture, is based on a grid system. Vertical and horizontal elements combine to form the structures of a cloth just as they do in a building. How these elements are combined will determine the form of the final product. Architectural theories offer designers of three-dimensional textile forms definitive examples of how an object's form can be determined by its structure. Zevi (1957), defined architecture as, "that which takes into account interior space" (p. 28). Ching (1979) also offered a broad definition of architecture through spatial geometries and experiences:

> Space constantly encompasses our being. Through the volume of space, we move, see forms and objects, hear sounds, feel breezes, smell the fragrances of a flower garden in bloom. It is a material substance like wood or stone. Yet it is inherently formless. Its visual form, quality of light, dimensions and scale, depend totally on its boundaries as defined by elements of form. As space begins to be captured, enclosed, moulded, and organized by the elements of form, architecture comes into being (p.108).

Both of these definitions leave themselves open to revisions through the inclusion of forms such as clothing, furniture, sculpture, fibrework and other vessels that encapsulate space.

F.L. Wright (Zelinsky, p.24), E. Saarinen (Wittkopp, 1994 , p.35), and Eisenman (Gorman, p. 60), are examples of architects who have considered the theoretical similarity between architecture and textile design (see Figures 15, 16, & 17).

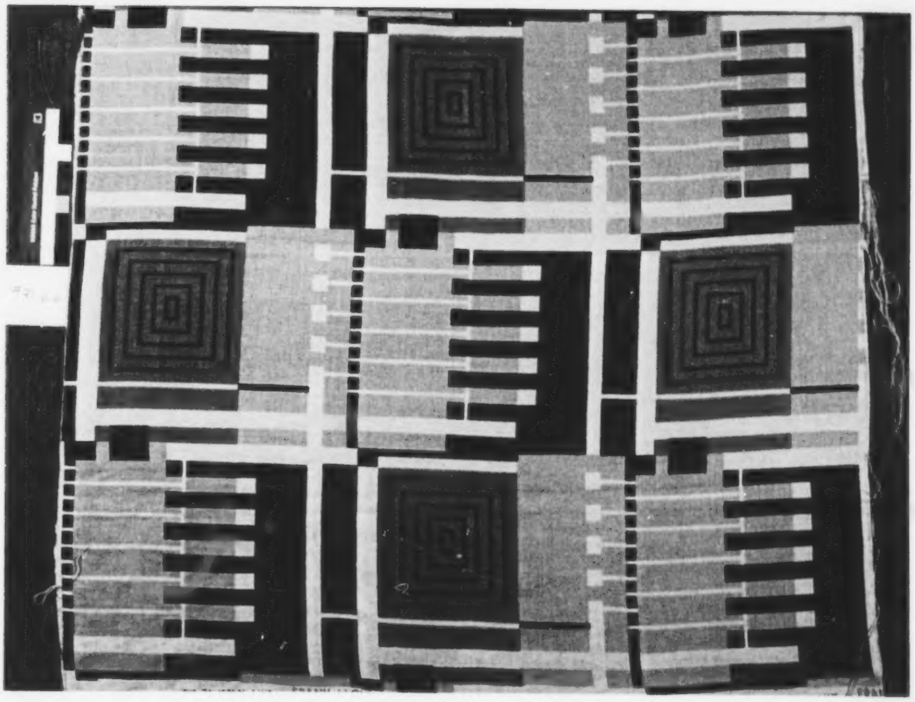


Figure 15. Frank Lloyd Wright textile #970.16.2 from the U of A, CLTX Collection. Dimensions; L=127cm, W=91.5cm (Photo by J.A. Renzi, 1995).

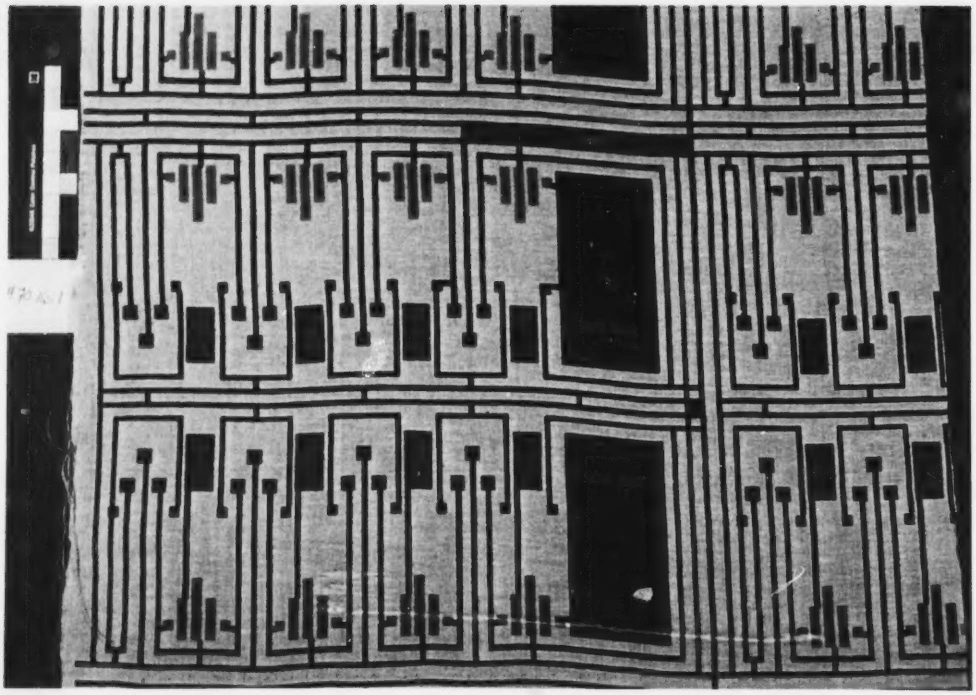


Figure 16. F.L. Wright textile Acc#970.16.1 from the U of A, CLTX Collection. Dimensions; L=127cm, W=91.5cm (Photo by J.A. Renzi, 1995).

These architects interpreted their architectural drawings into textile designs, translating flat, two-dimensional images into flat patterned weave constructions. The woven textile designs once created and placed within the original architecture, created a harmonic balance between decorative objects and functional spaces (see Figure 17).

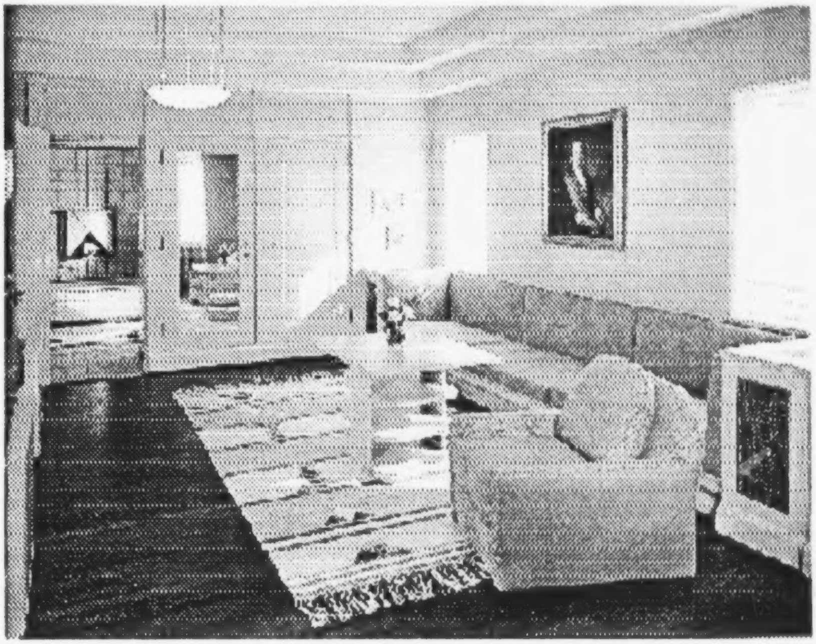


Figure 17. Saarinen house with textiles designed specifically for the home (Wittkopp, 1994, p.37). Reprinted with permission from the Cranbrook Art Museum.

Form derived from structure or "structural form", as stated by Siegel (1962), is part of the theoretical basis of my works. In other words, the whole equals the sum of its parts. Siegel referred to architecture of the Gothic period as perfect examples that convey the principles of structural form:

> We want it [structural form] understood as *a characteristic, significant form determined by the structure* [italics added], which, being rooted in an architectural, yet natural order, transcends the particular and acquires a generalized power of expression. (p. 8)

According to Siegel, detailed structures such as "the prominent vault ribs of the great Gothic cathedrals" (p. 10), are decorative yet serve a structural purpose (see Figures 18 & 19). This theoretical view was shared by von Simson (1962), recognized by Scully (1991) as "the most important study of Gothic symbolism yet written" (p. 155). von Simson identified "the new relationship between function and form, structure and appearance" (p. 4) as key features of Gothic architecture, and Zevi (1957) stated that, "in many cases, container and contained are mutually interdependent, as in a French Gothic cathedral" (p. 24). The aesthetic form of a Gothic cathedral is determined by "the vault ribs and supporting shafts" (p. 5) continued von Simson, the final outcome depending upon the structural components used to construct the building.

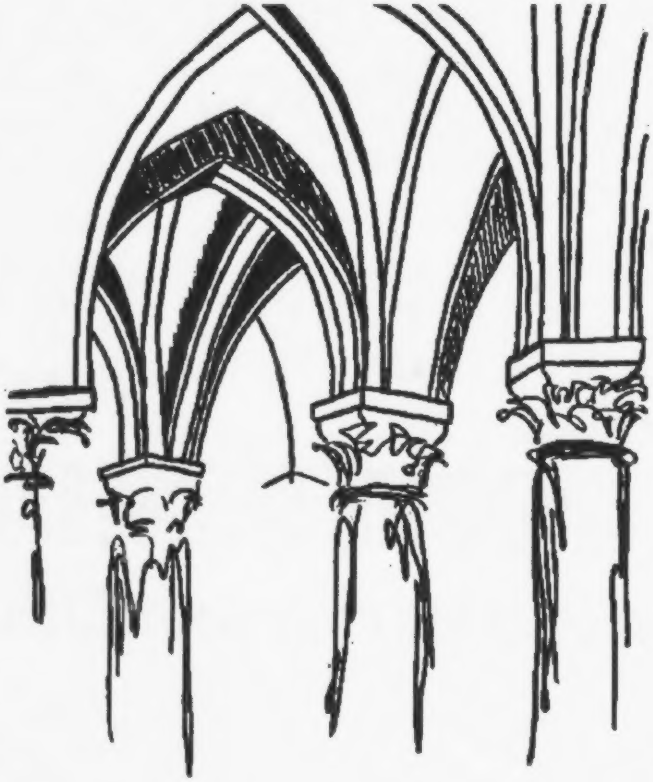


Figure 18. Gothic cathedral vaulted ceiling with columns. (Sketch by J. A. Renzi, 1995).

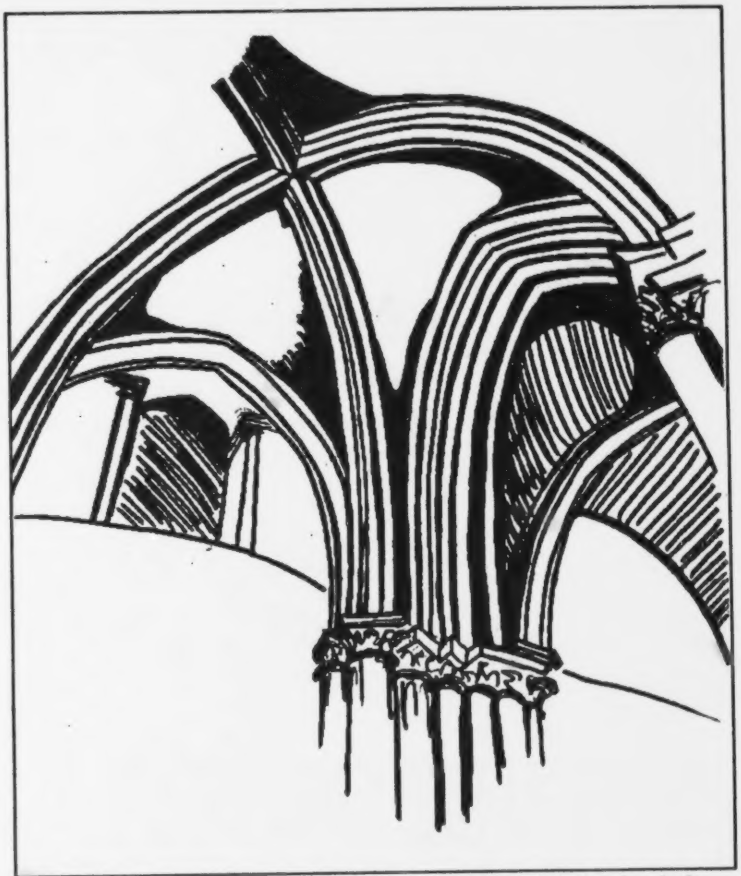


Figure 19. Vaulted ceiling of a Gothic cathedral. (Sketch by J. A. Renzi, 1995).

Textile Architecture

Similarly, three-dimensional textile forms depend upon weave structure created on the loom in order to obtain the alternating planar formations that will eventually become an aesthetic object. These woven structural forms are shaped in accordance with how the structural elements, the warp and weft threads, are placed within the fabric construction. Looking at these elements as a whole cloth, fabric architecture was recognized by Siegel (1962) when discussing structural form; "Tents are of special importance to a discussion of structural form, since *the form of a tent is itself the structure* [italics added]. In no other type of construction does the form flow so spontaneously from the structural principle" (p. 298).

Tent structures have been influential in the development of architectural textile forms. Faegre (1979) referred to these portable environments as the "simplest dwellings we know of" (p. 1) and offered the tent structures of different nomadic cultures as examples. Bedouin black tent construction and environment as described by Ferdinand (1993), and Mauger (1991), and photographed by Carter (1983), present the ability of human beings to exist in harsh natural surroundings through the shelter of textile forms.

These structures not only provide shelter but also create intimate, personal spaces within the infinite and open desert. However, the exterior environment is not completely shut out, as only three of the four sides of the bedouin tent are enclosed to protect against wind. The dramatic quality of these dark, vertical constructions imposed on the neutral, horizontal plane of the desert and the fluidity of the sand and woven fabric, attracts the eye to this balance of contrasts and semblances.

Modern architects and engineers, such as Frei Otto and Horst Berger, have employed these portable tent forms to create "rigid tensile structures" (Rush, 1980, p. 110) in their permanent architectural designs (e.g. the Haj Terminal, in Jedda, Saudi Arabia). The attractive curves that are created by fabric under tension have yet to be duplicated by any other building medium.

Rush presented good arguments for the use of fabric structures as architectural forms, giving reasons why fabrics are not used more in traditional building applications due to negative perceptions of fabric as a building material; "the largest single drawback to the fabric structure is the preconceived notion that it is something to fold up and use to go camping: a tent" (p. 110). Rush argued that existing fabric tensile structures have been proving successful in their applications in diverse geographical climates (p. 110).

Fabric structures have been employed in interior design situations, excluding conventional interior design applications such as upholstery and window coverings. Wagner (1993) quoted architect Tom Dalland, "there are no flat planes in the human body. It is made completely with surfaces that curve in two directions" (p. 96). Tom Dalland and his associates seek to create interior spaces that reflect nature using curvilinear forms and surfaces. These shapes are achieved by utilizing materials according to their characteristics and enhancing them through exaggeration. Fabric structures under tension (fig. 20), are used to allow the architect or designer to work with curved geometry (i.e. parabolic shapes). Dalland's approach to interior design is directly related to the function of the space being utilized, in this instance, a fashion showroom intimately related to the female body.

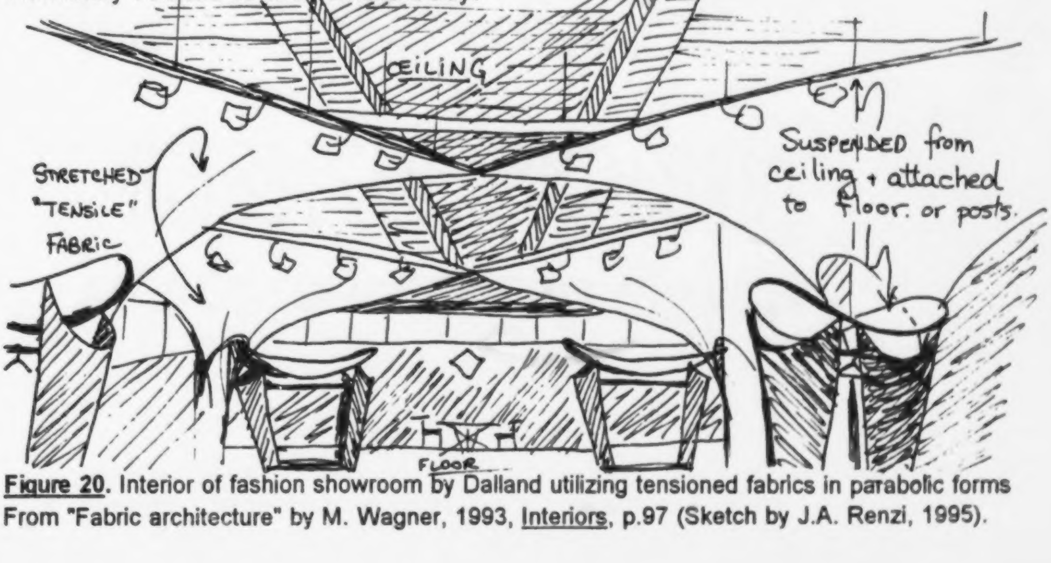

CEILING
SUSPENDED from ceiling + attached to floor or posts.
STRETCHED "TENSILE" FABRIC
FLOOR

Figure 20. Interior of fashion showroom by Dalland utilizing tensioned fabrics in parabolic forms From "Fabric architecture" by M. Wagner, 1993, Interiors, p.97 (Sketch by J.A. Renzi, 1995).

Another potential for tensioned fabric structures is suggested in interior designer Gisela Stromeyer's use of fabrics under stress to create unique lighting treatments. The shadows effected by the curvilinear shapes of her tensioned fabric covers create an interesting atmosphere. "Stromeyer manipulated stretchy fabrics anchored into walls and ceilings to create sculptural membranes with sensuous three-dimensional curves to reflect light" (Zelinsky, 1992, p. 38).

Siegel (1962) discussed modern architecture as a technologically biased medium completely devoid of art when it should be an assimilation of the two. A basis for the proposed study is presented and supported by Siegel during his discussion on tents and fabric structures:

> There is an unlimited abundance of possible shapes. Designing them is more a job for an artist with a good sense of form than for a mathematician. In developing new forms, experiments on models can be extremely fruitful, while "exact" mathematical techniques are virtually useless. (p. 300)

Rush (1980) cited the architect Roy Hall who also promotes the use of models in order to encourage the development of aesthetically pleasing and structurally sound fabric architecture: "models are a must" (p. 112). Siegel berated modern architecture by stating that the harmony of art and architecture has shifted, and contemporary architecture has replaced the artistic aspect of architecture with engineering and industrial design. The smaller scale of my finished pieces could be viewed as models for possible future use in architecture.

Architecture and multi-dimensional space

Zevi (1957) described architecture as "a great hollowed-out sculpture which man enters and apprehends by moving about within it" (p. 22). The relationship presented by Zevi has switched from form derived from structure to the existence of structure and form within space. Zevi stated, "internal space, that space which...cannot be completely represented in any form, which can be grasped and felt only through direct experience, is the protagonist of architecture" (p. 23).

The author suggested that when the artists of the late 1900's discovered the concept of the fourth dimension of time, adding an infinite dimension to the three dimensions of perspective, they left out the dimension created by the actual physical participation of the observer:

> But in architecture we are dealing with a concrete phenomenon which is entirely different: here, man [sic humans] *moving about within the building*, studying it from successive points of views, himself creates, so to speak, the fourth dimension, giving the space an integrated reality (Zevi, p. 27).

Zevi explained this concept of the fourth dimension as follows:

> There is a physical and dynamic element in grasping and evoking the fourth dimension through one's own movement through space. Not even motion pictures, so complete in other respects, possess that main spring of complete and voluntary participation, that consciousness of free movement, which we feel in the direct experience of space (p. 59).

Zevi's explanation of the creation of dimension by one's conscious existence within space, be it interior or exterior, is universally experienced yet subconsciously realized. This occurrence within the conscious mind could also be related to the contemporary terminology "virtual" reality, yet what Zevi describes occurs in the person's immediate plane of existence or "actual" reality. Norberg-Schulz (1971) refers to it as "existential space" with architectural space as its physical counterpart (p.37). I have personally experienced this phenomenon when encountering an actual art object or a building in reality that I had previously viewed in a photograph, slide, or film. Once I had occupied the same plane of existence as the art object or architectural space, they became real and as such had a more powerful emotional effect on me, the viewer.

Personal Physical Experience within Architectural Spaces

> "The flower, the plant, the mountain stand forth, existing in a setting. If they one day command attention because of their satisfying and independent forms, it is because they are seen to be isolated from their context and extending influences all around them. We pause, struck by such interrelation in nature, and we gaze, moved by this harmonious orchestration of space, and we realize that we are looking at the reflection of light" (Le Corbusier, 1948, p.7).

Le Corbusier understood the emotional effect an object within an environment could have on an individual. Space and an object occupying that space lends itself to unlimited possibilities within one's intuitive mind.

Scully (1991) stressed the importance of discussing direct personal experience when exploring Gothic architecture. Not only is the structure of the building important, but also the symbolic experience intended by their construction and design. This type of experience is not limited specifically to Gothic but can also be applied to other types of architectural forms.

Conti (1978) explored a spiritual and environmental relationship created between man and architecture where, "a special sense of place and atmosphere distinguishes some cities and places from others and gives them a unique life"(p. 6). An example of this relationship presented by Conti is the mountain city of Machu Picchu in Peru.

The beautifully executed photography of G.E. Kidder Smith (1990), also depicts the environmental experiences collected by the author. Kidder Smith's black and white photographic compositions offer infinite inspirations for my architecturally based textile art pieces. Although these examples are not directly personal, past experiences with similar architecture aids in my relating to the author's own architectural encounters.

My sojourn in Italy during the progression of this study had an immediate effect on the conception of my three-dimensional forms. The emotional experience I had is difficult to verbalize, but using photographs taken during my visit, I will attempt to describe my inspirations.

The architectural wonders of Italy will never cease to astound me, beginning with Rome and the interior of the pantheon (fig 22). The enormity and age of the structure overwhelms, yet at the same time the vast interior space calms. The spherical structure encompassed me as though I had entered a giant globe, with each individual niche creating it's structure. Even with the crowds surrounding me, I felt individual, like I had a place as I stared up at the oculus where the sun came in.

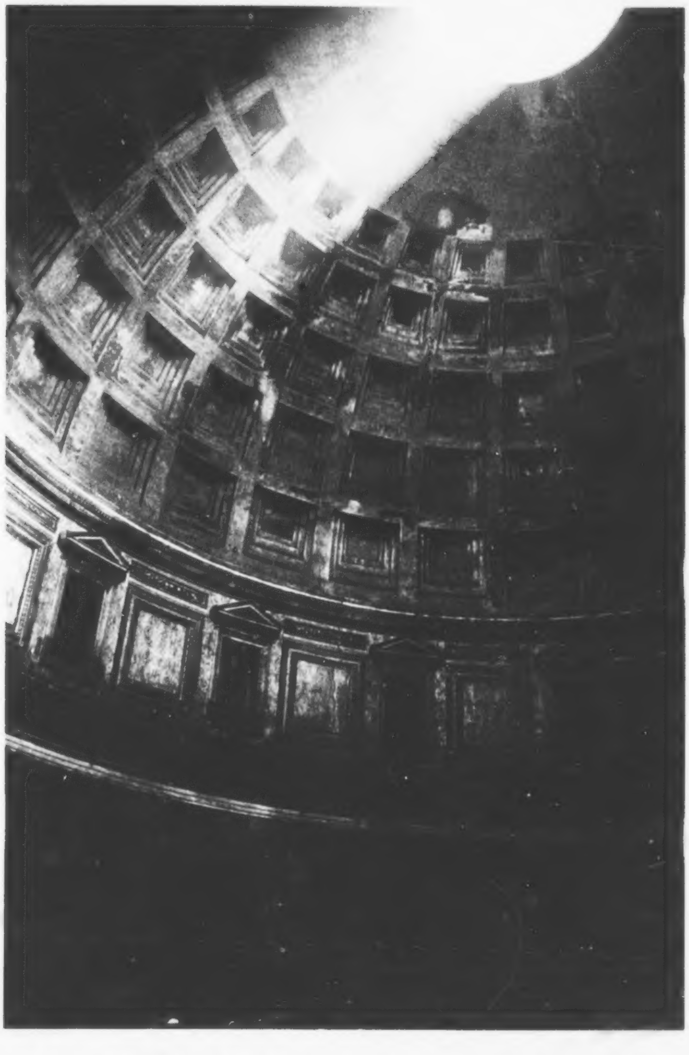


Figure 21. The Pantheon, Rome; interior view of the dome. (Photograph by J. A. Renzi, 1994).

The ruins of Rome, megalithic shadows of structure, such as the Baths of Caracalla (fig 22), the Colosseum (fig. 23), and the Forum (fig 24), show that even through destruction, a harmonic balance can be achieved. Interior space has become exterior space; although I was surrounded by walls, I could see the sky without the barriers of windowpanes.

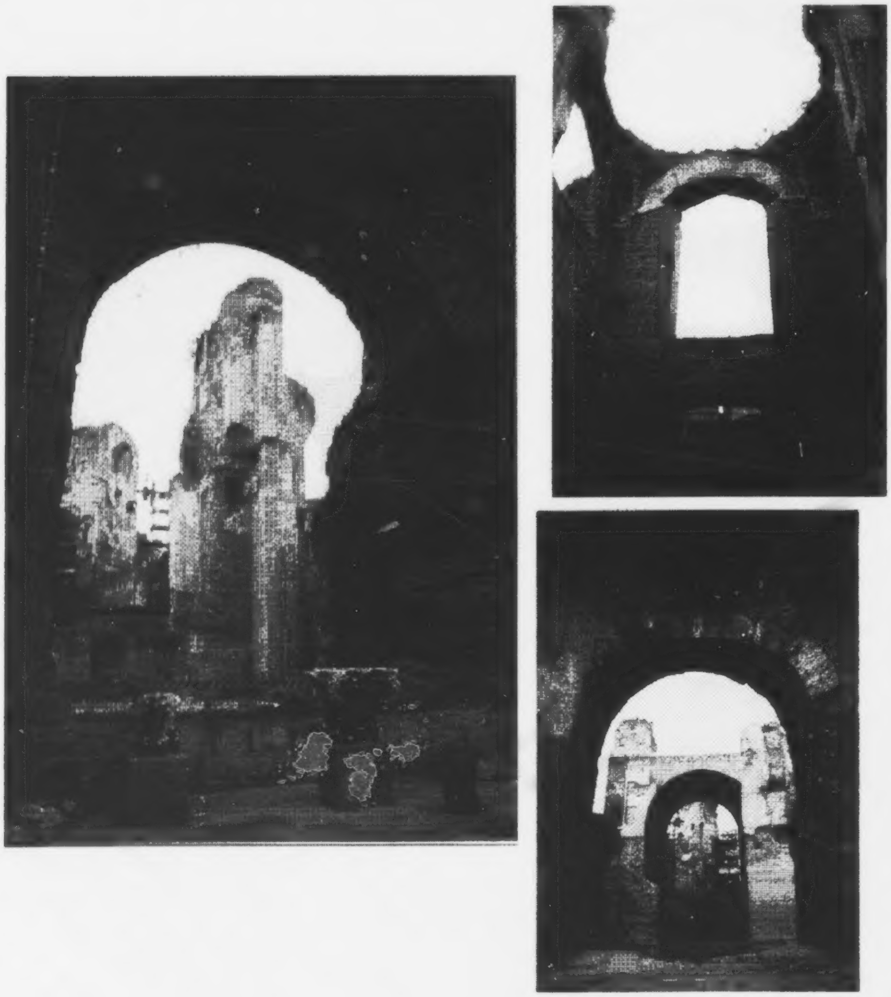


Figure 22. The Baths of Caracalla in Rome, structural form combined with weathering creates new inspirational forms. (Photographs by J. A. Renzi, 1994).

The ancient Roman Colosseum, resembles a giant pastry with a bite taken out of it. The Forum shows quiet structural solitude, the crumbs of columns lay undisturbed even by the hundreds of street cats that lounge about them. The imposing proportions of this architecture yearns for people to enter it's decomposing shell. But a stately elegance and structural presence remains, reassuring humankind with perseverance and strength of history.

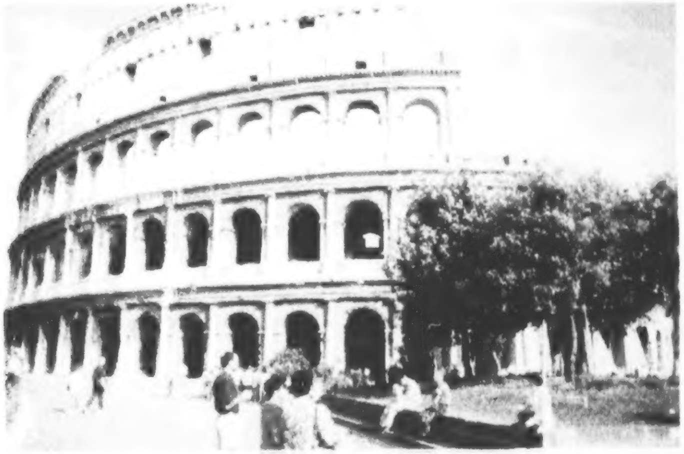


Figure 23. The Colosseum stands, crumbling from pollution, structure intact. (Photograph by J. A. Renzi, 1994).

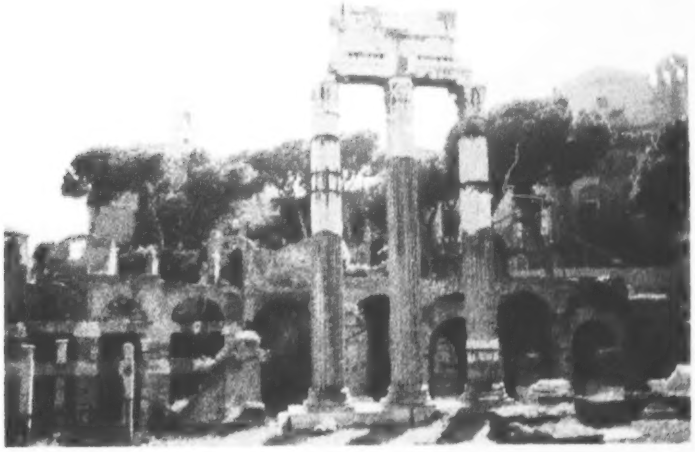


Figure 24. Remnants of columns at the Forum. (Photograph by J. A. Renzi, 1994).

The unsurpassed beauty of Venice's canals, Florence's art and the architecture of both, inspired me to analyse structural details within my surroundings. In contrast to how modern North American needs are met, the necessity of building bridges and balconies in Venice (see Figure 25) is approached artistically by adapting existing historic styles. The classical structures evident in Florence's architecture are so squeezed together, they summoned my curiosity to venture down dark alleys. I was focussed on exploring the historic Cathedrals and the smaller, inconspicuous churches with their subtle art forms. Even when an open piazza, such as Piazza della Signoria, is encountered the city seems to open up it's arms to crush you in welcome.

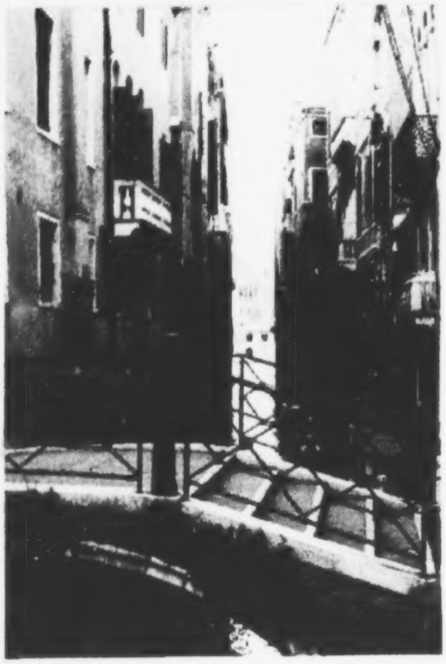


Figure 25. A bridge structure spans a Venice canal (Photo by J.A. Renzi, 1994).

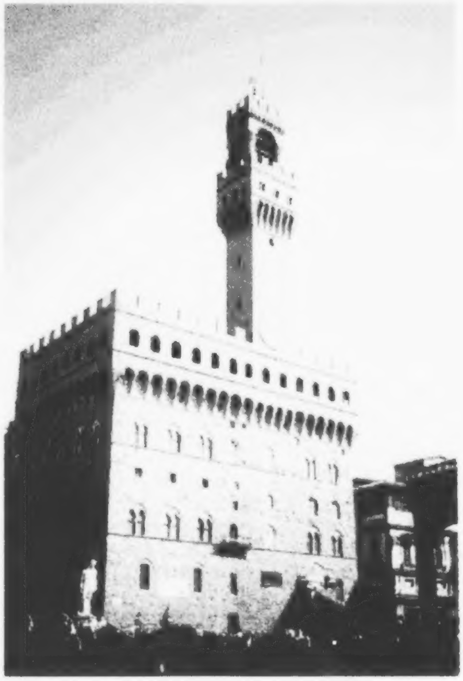


Figure 26. Palazzo Vecchio in Piazza della Signoria in Florence (Photo by J.A. Renzi, 1994).

My first encounter with the house where my Grandfather was born (see Figure 27) was amazing. The house was abandoned; the sole building on the hillside property. The vegetation grew wild and brushed my shoulders as I walked the perimeter of the house.

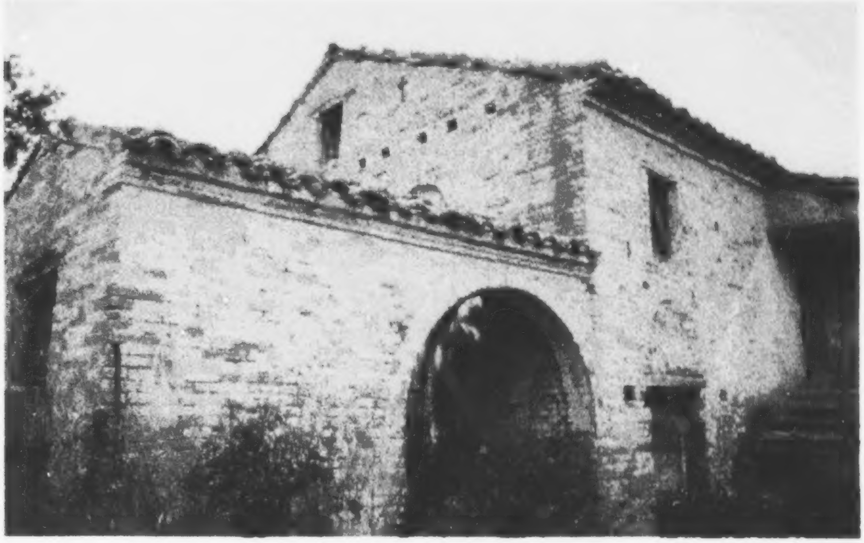


Figure 27. The house where my grandfather grew up, in San Elpidio a Mare, Italy (Photo by J.A. Renzi, 1994).

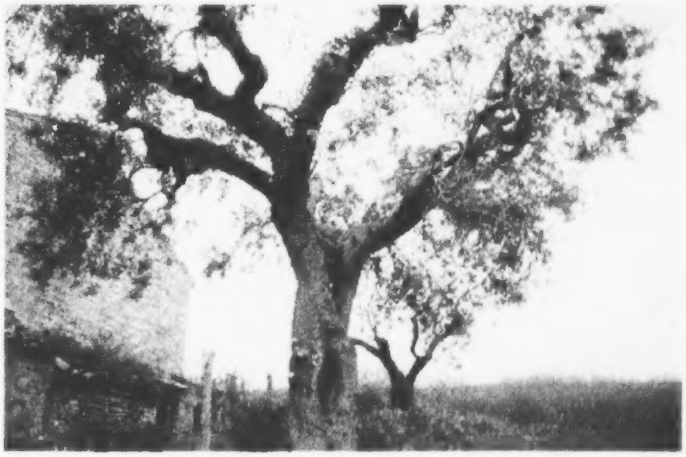


Figure 28. The twisted trunk of an olive tree on the same property (J.A. Renzi, 1994).

The weathered stone, and arched doorways of the vernacular architecture along with the twisted, ancient olive trees surrounding the house (see Figure 28), created an atmosphere of peace mixed with melancholy. I could sense my history from this environment. The house was located on the narrow road leading into the medieval hilltown, San Elpidio a Mare (see Figure 29). The town celebrates many festivals throughout the year. Traffic is banned from the narrow streets, and the citizens adorn the buildings with torchlight and brightly coloured flags representing the four quarters of the town.

Figure 29. The old town of San Elpidio a Mare at night during a festival (Photo by J.A. Renzi, 1994).

Japanese Architecture

The inclusion of exterior space was noted by Zevi by comparing natural environmental spaces to those produced by human beings, "it is certain that all urban space wherever the view is screened off, whether by stone walls or rows of trees or embankments, presents the same features we find in architectural space" (p. 29). The Japanese concept of interior space also includes exterior view in the creation of domestic and public living spaces. The organization of public and private spaces in Japan reflects the harmonic balance between nature - the exterior, and humans - the interior.

Thompson, Blake, & Yasumasa (1988), visited a northern Japanese village and partook in one of their annual rituals in order to understand Japanese rural concepts of public and ritual space. Their research revealed to those unfamiliar with it, the Japanese theory of Ma which the authors saw as the key to understanding Japanese space. "Japanese ma, or space-time, is not fragmented, labelled and contained like space in the West, but is rather an emptiness or void that gains its form only in relation to unseen boundaries created by the activities performed in it" (p. 9).

Ma allows the Japanese architect to explore unlimited architectural interpretations of space by allowing constant shifts in space and time, "Ma is constantly awaiting or undergoing transformation by the availability of physical components and potential uses" (p. 9). Thompson, et al. said the Japanese do not permanently allocate specific functions to certain spaces, but let the space itself transform to whatever purpose necessary through the physical interpretations of objects within the "negative" space. How I approach the installation of my work is greatly affected by this philosophy. Where my artworks are placed, how they effect the people existing within the space, and how they transform the space they occupy, were important considerations when I designed and installed my work. According to the Japanese concept of space, walls are not always necessary, four posts connected by a rope may designate a sacred space. Using this small textile object, only a suggestion is needed in order for a space to be observed. This type of space is created by what we call in the west - invisible barriers.

Futugawa, Itoh, & Noguchi (1963) presented a survey of the roots of Japanese architecture, analyzing composition and simplicity of space within classic Japanese architecture. Futagawa, et al. described the Japanese perspective of spirituality in architecture by stating that although the architects would create great spatial enclosures, "they refused to admit that there ever could be a limit to the spaces they enclosed" (p. 58). This characteristic of Japanese architecture is described by Futagawa, et al. as setting a limit to infinity on the outside, re-creating a miniature universe on the inside, or its own new infinity (p. 58).

Three-dimensional Forms

Natural & Sculptural Forms

The harmonic balance between humans and nature is a strong spiritual necessity when creating domestic environments. Japanese architecture is not the only cultural medium to develop this attitude. Western textiles and architecture, for instance that of the Arts & Crafts period (see Figures 54 & 55, Acc#986.32.1, & 986.32.2), and the prairie architecture of Frank Lloyd Wright (i.e. Falling Water, a home built to incorporate the trees and waterfalls of the land it was built on), are examples of harmonizing the manually produced with the naturally occurring. All of us desire to bring our natural surroundings that we experience in the outdoors, indoors with us. Our houses have windows allowing us to view the outdoors while indoors, we place flowers in vases, display seashells on our shelves, and we may even use tree branches as decorative objects.

Structural form in nature, in contrast to structural form in architecture, has always existed. The German biologist and philosopher Ernst Heinrick Haeckel (1834 - 1919), to whom the name ecology is accredited, was fascinated by natural forms. His drawings of exotic organic life forms (see

Figure 30) such as, deep-sea microorganisms called radiolaria, plants, larger marine life, and rare animals, originally published in 1904, were reprinted by Dover Publications in 1974. This collection of plates serves as an inspirational source of infinite abstract designs for artists and designers.

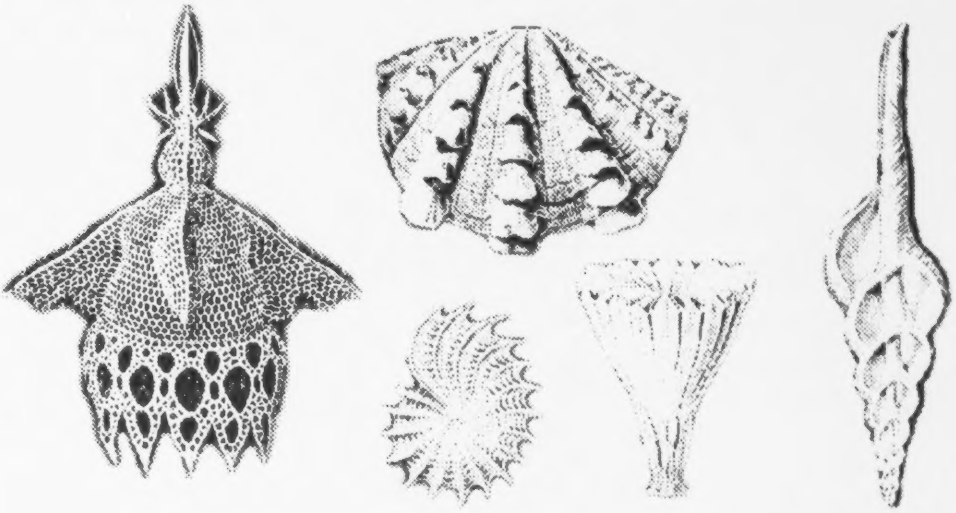


Figure 30. Haekel's radiolaria and marine life, forms from nature that provide inspiration for three-dimensional textile designs. Taken from Art Forms in Nature (pp.2,9,31,53,& 55) by Ernst Haekel, 1974, New York: Dover Publications. Reprinted free and without special permission, provided that less than ten illustrations included in the same project, from Dover Publications.

How natural objects exist within space; their shape, size, and location, is often conveyed in artistic media. For my fibre art, I derived three-dimensional design inspiration from the various positive and negative spaces and forms that occur in nature and architecture. The final outcome of each piece differed depending upon the artistic conception of each. According to Randall & Haines (1965) obtaining "ideas from nature and man-made environments"(p.14) for three-dimensional design is the first of five main categories they discuss. Some design examples based on natural forms are; Japanese wrapping techniques, and Thai wrapped and basket forms.

As mentioned previously, the Japanese culture is one that maintains a harmony of spirit, or basic understanding, between man and nature. Oka (1975) explained, "in Japan...man has usually lived as part of nature, being embraced by it and commingling with it" (p.11). The art and design of Japan reflects this understanding through a combination of simplicity of form and utilitarianism. Figure 31, exemplifies the beauty of nature found in the materials of traditional wrapped and packaged forms. The packaged forms incorporate the inherent natural physical traits already present in the media being used. According to the author, "they are whispered evidence of the Japanese ability to create beauty from the simplest products of nature" (Oka, p. 9).

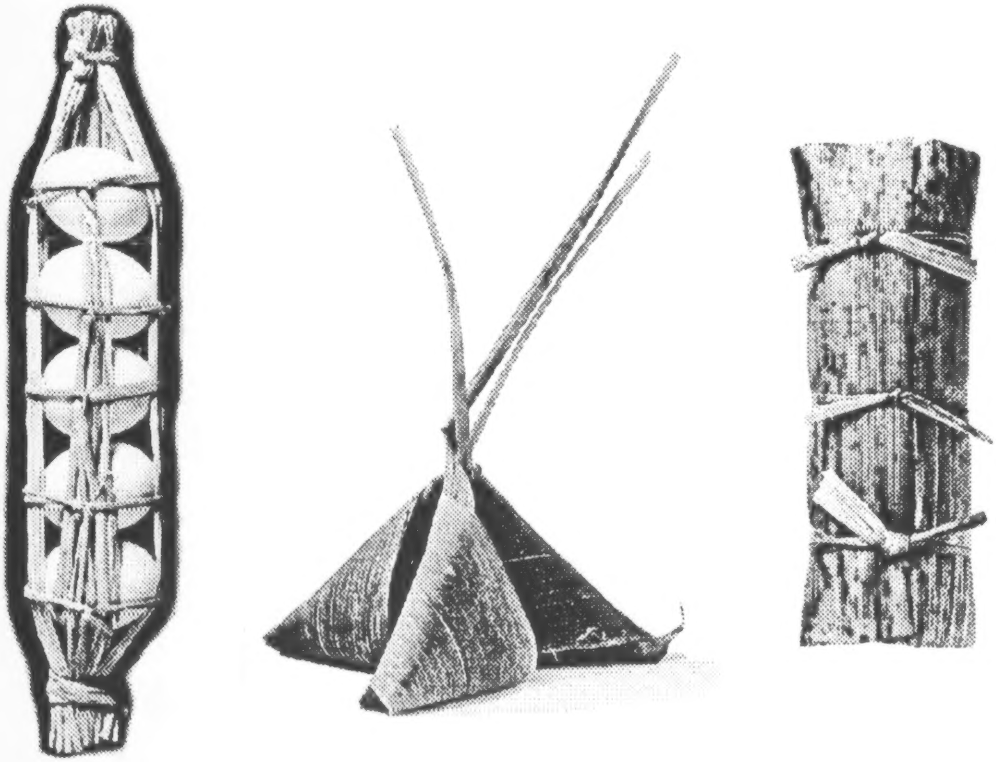


Figure 31. Japanese wrapped forms created from the juxtaposition of two objects, the wrapped and the wrapping materials. From left to right; rice straw with eggs, *kumazasa* bamboo leaves around bean jam candy, and rice wrapped in bamboo sheath (From How to wrap five more eggs: Traditional Japanese packaging by Oka, 1975, plates #12, 19, & 20. NY: Weatherhill). Reprinted with permission.

Similarly, the everyday objects of Thailand have unique forms based upon an alternate cultural view of natural forms, yet, the influence of nature is prevalent. Beurdeley & Hinz (1980) wished to "emphasize the connection between the living and plastic forms of the most familiar objects" (p.V) through a visual documentation of Thai objects. The shaped leaf sculptures, curling architecture, musical instruments, food containers, and various woven bamboo structures, evoke a sensitivity to nature, a sensitivity that is often ignored in the mass-production of everyday objects in western cultures (see Figure 32).

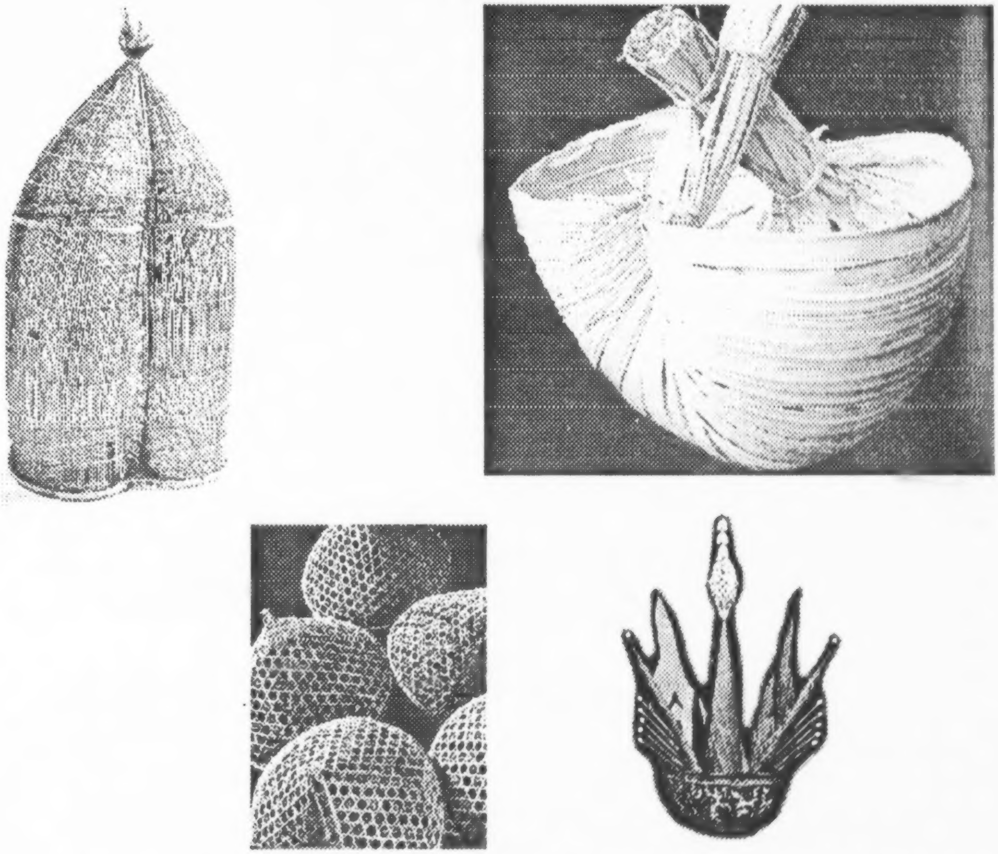


Figure 32. Thai forms, clockwise from left; plaited bamboo fish trap, well bucket of palm leaves, triaxial, ceremonial flower sculpture offering, wickerwork cones to protect food (From Thai forms by Beurdeley & Hinz, 1980, plates 75, 82, 62, & 1. NY: Weatherhill). Reprinted with permission.

Textile forms

Current three-dimensional fibre artists seem to have adopted architectural and natural theory in the installation of their work. This alternative delineation of space is noted in the works of such fibre artists as, Mitsuo Toyazaki (see Figure 33), and Shihoko Fukumoto (see Figure 34). Upon entering the exhibition space containing this work, the viewer would immediately sense invisible boundaries that are either inviting or defensive, confining or spacious. The fabric forms are not permanent nor are they dispensable. Views are partially obstructed due to the varying size and transparency of the fabrics. The viewer is presented with a choice, to either enter into the space created and interact with the textiles, or not enter and remain a non-participant observer.

Figure 33 was removed due to copyright restrictions.

Figure 33. Toyazaki's installation work *'Social Plants', 1988* (Colchester 1993, p.142).

Figure 34 was removed due to copyright restrictions.

Figure 34. Fukumoto's indigo installation *'Shades of Indigo Blue'* in a NY gallery (Ruyak, 1994, p.40).

The method and location of display play an important role in the successful interpretation of a fibre art installation. Once space or a non-entity has been given a specific area to occupy, such as a curvilinear form, the angularity of a planar room may soften. The juxtaposition of the form within an architecturally contained space will then directly relate to the negative spaces created within the form and the room it occupies. Dona Meilach (1974) augmented this idea of textile form within space when she stated, "Creating a successful woven three-dimensional form involves a stronger discipline than simply stuffing a double-weave or bending a woven strip around itself; the structure must be convincing as a result of its commingling with inner and outer space" (p.127-128).

The inherent physical characteristics of the materials used are also important in creating a successful three-dimensional textile form. The artist's sensitivity to the materials, and their reaction with their surrounding environment, lends to the success of a fibre art work. The hand and drape of the fabric and the reaction of these characteristics with air currents, light, and gravity all contribute to the spatial construction.

Visual explorations of contemporary three-dimensional fibre art play an important role in the development of innovative three-dimensional fibre-art. Detailed analysis of the works by Paul R. O'Connor (see Figure 35), Jean L. Kares (see Figure 36), and Kay Sekimachi (see Figure 37) offer me, as a textile designer, multiple means by which my three-dimensional structures can develop. Yet, through the literature I have examined, I have observed that although these three-dimensional woven forms are based on the same traditional weave structures, the resulting designs are quite diverse. These differences in design may be due to the various personal processes and techniques utilized by each artist. Whether it is in the form, technique, materials, colour scheme, or textural effects of the fibre art, many original ideas can generate from the impetus provided by other artists of three-dimensional textiles.

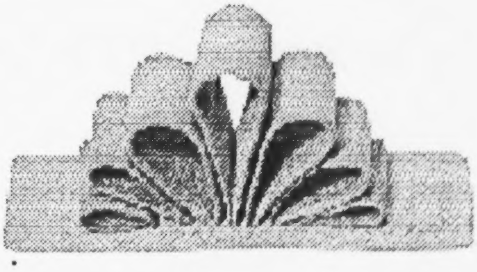


Figure 35. O'Connor's *"Christmas Ribbon", 1990*, 2.5" x 9.5" x 5" (O'Connor, 1992, p.71). Reprinted with permission.

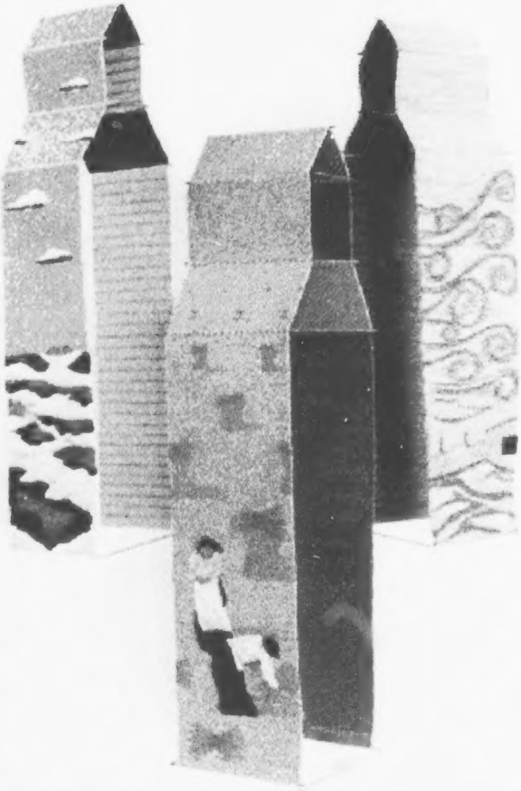


Figure 36. Three-dimensional tapestries from the *'Elevator Dreams' Series* by Jean L. Kares. Centre piece, *"Patterns of Harvest"* is the largest at 7" x 7" x 30". Reproduced with permission from the artist.

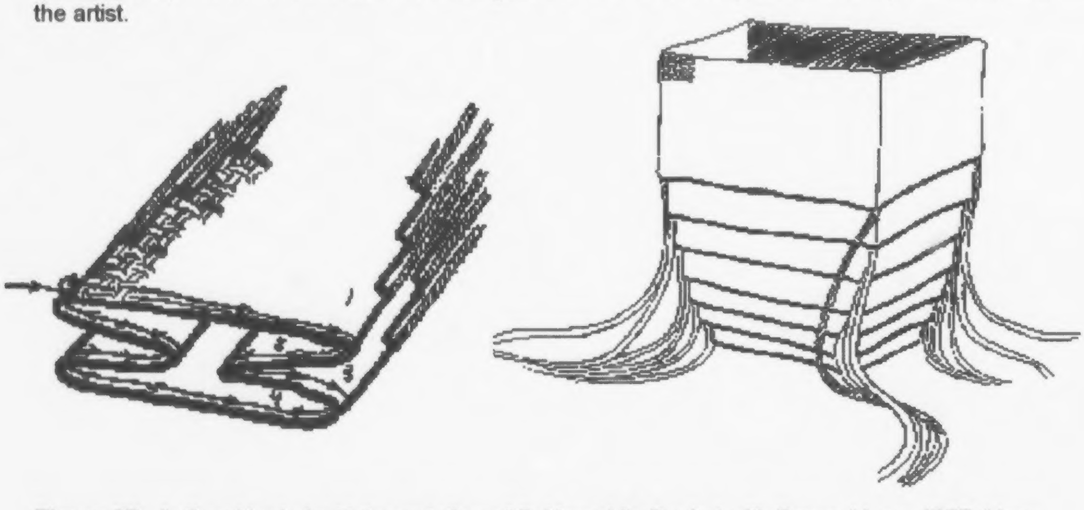


Figure 37. Authors' technical interpretation of Sekimachi's *Basket with Brown Lines, 1977, Linen, 6" x 4.5" x 4.5"* (Sketch by J.A. Renzi, 1995).

Weaving Technology

The technological basis for my research project is one steeped in centuries of tradition. It has only been within the last few decades that hand-woven textiles have become more recognized as a viable art form. Three-dimensional textile sculpture rose to popularity by the end of the nineteen-sixties (Constantine & Larsen, 1982, p.123). The freeform technique of tapestry weave allowed for massive creative fibreworks to be developed, shifting wall-hung, flat, pictorial weavings to three-dimensional environmental structures. Unfortunately, in the past five years, there has been little research published in the area of exploratory interpretation of double-woven textile structures due to the return of three-dimensional fibre art back to the flat wall.

Structural Development of Multi-layered Weave Design

Weaving is based on a grid framework with the weft and warp threads running perpendicular to each other. The order in which these threads cross one another to achieve a stable structure will result in particular patterns and structures. The simplest weave structure is a balanced plain weave (see Figure 38), although it is limiting in its choice of imagery.

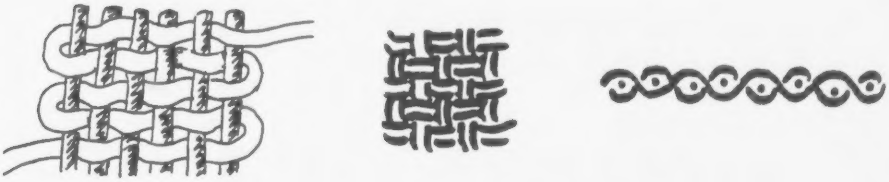


Figure 38. Various representations of plain weave structure (Sketches by J.A. Renzi, 1995).

By combining sets of grids and alternating their sequences, the layers of warp and weft threads can work together to form a new structure. In this section, I am not presenting an historical survey of double-weave, but a brief technical description using historic examples. The following is a summary of the visual and technical analyses of double-woven pieces housed in the University of Alberta, Department of Human Ecology, Clothing and Textiles Collection.

Historic Aspects

The earliest evidence of double-weave technology is attributed to the ancient Peruvians of the Early Horizon Period (1400 - 400 BC), who developed an unlimited range of possible structure/image combinations (Cahlander A., & Baizerman, S., 1989). The possible origins of double cloth may be attributed to the development of the backstrap loom (see Figure 39, Acc# 985.061.001). The looms used by the ancient Peruvians had no reed but a heddle rod. Without a reed, warp spacing cannot be controlled without a close warp-weft relationship. Double weaves may have provided a solution to this problem.

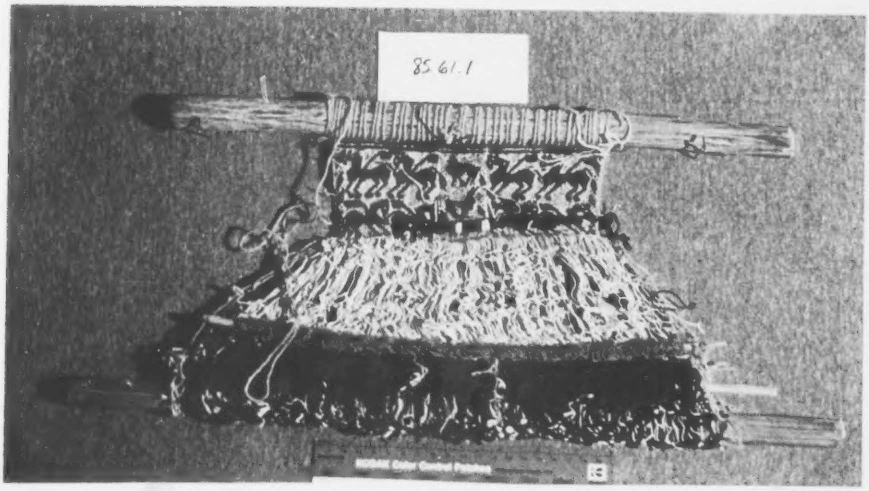


Figure 39. Example of a back-strap loom from Bolivia Acc#985.61.1 from the U of A, CLTX collection, L=24cm, W=52.5cm (Photo by J.A. Renzi, 1995).

Wide ancient Peruvian cloths, wider than a back-strap loom could produce, may have been double-woven and then opened up to wider widths off the loom. Brostoff (1979) notes; "Backstrap looms in particular were limited in width and double and triple weaves provided the opportunity for wider and more decorative cloths than would otherwise have been produced" (p.4). This is made possible by winding a wide warp, doubling it up on the loom, and attaching the right or left selvedge edges with the weft during the weaving process (Figure 40) . This weaving technique is called double-width weave and, as speculated by Brostoff, could very well have developed into an interchanging of warps within the one fabric creating double-weave patterns. Triple and quadruple width cloths can also be produced by adding a third and fourth warp (Figure 41). Although there are no examples of these types of textiles in the collection, I have utilized this structure and it's characteristic crease fold that is created at the joined selvedges.

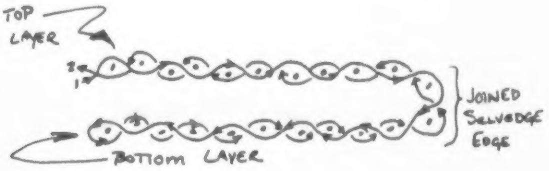


Figure 40. Cross-section of a double-width weave showing the path of the weft thread (Sketch by J.A. Renzi, 1996).

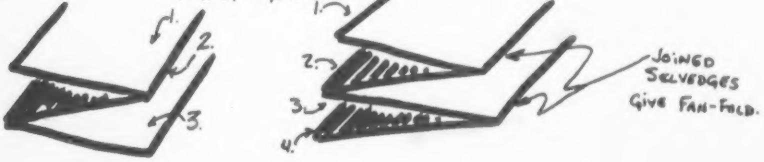


Figure 41. Representation of triple and quadruple-width weaves showing the characteristic creased fold at the selvedge (Sketch by J.A. Renzi, 1996).

Peruvian double weave structure was mostly used for creating patterns in the cloth. Artifacts #986.37.1 and #984.017.005 are two examples of peruvian double weaves, one depicting animals and showing the reverse side (refer to Figures 42 & 43). The various patterns were achieved through the use of a pick up stick, a technique still in use today. In Finland this pick-up technique is called *finnweave,* a term many still use today in reference to double weave (Keasbey, 1984, p.80). Artifact#993.022.143 (see Figure 44) is a double woven bag from Mexico, created using a Mexican pick-up technique, depicting a goat or deer.

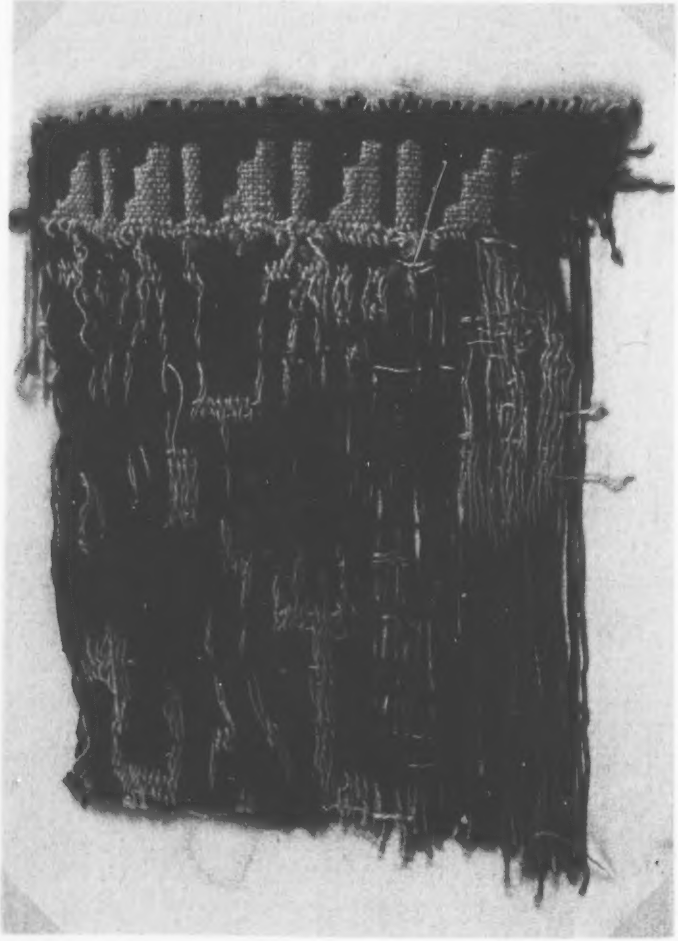


Figure 42. Artifact #986.37.1 from the CLTX Collection. Dimensions; L=16cm , W=13cm (Photo by J.A. Renzi, 1995).

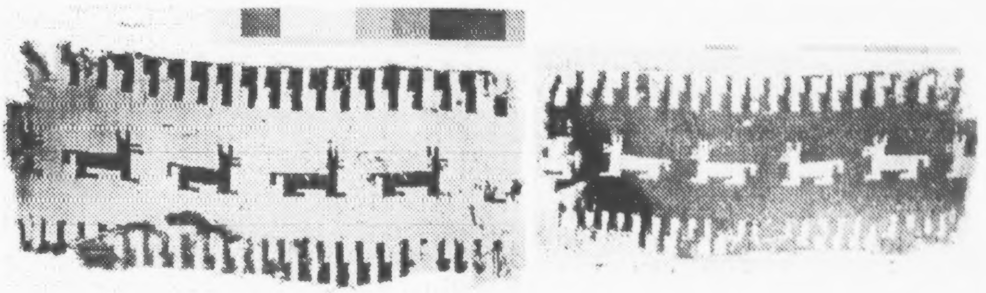


Figure 43. Artifact #984.17.5 from the U of A, CLTX Collection. Dimensions; L= 30.5, W=13cm (Photo by J.A. Renzi, 1995).

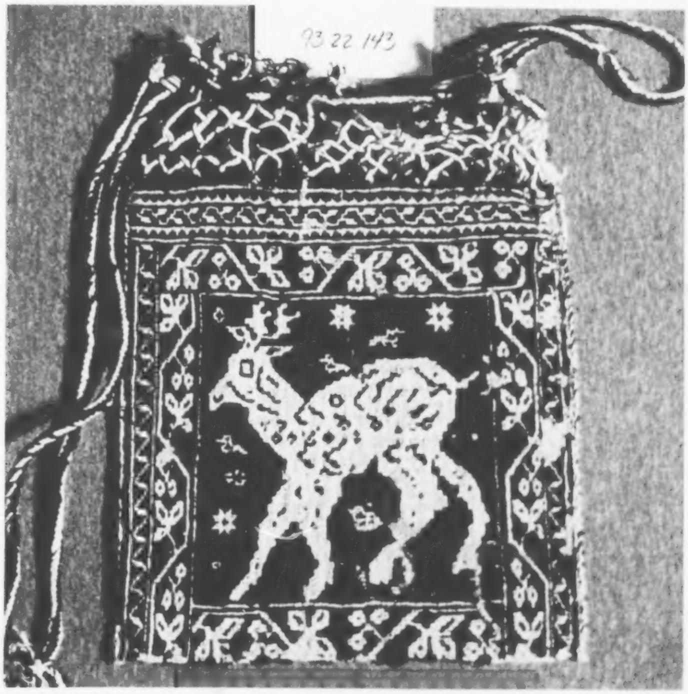


Figure 44. Mexican double-weave, pick-up Artifact #993.22.143 from the U of A, CLTX Collection. Dimensions; L=35.0cm, W=26.0cm (Photo by J.A. Renzi, 1995).

Technical Aspects

The main tool needed by a double weaver to begin a textile is the loom. The technique of balanced plain-weave double cloth requires that the weaver use a specific loom set-up. The Peruvians used backstrap looms, creating the warp tension with the interaction of their bodies. However, for the production of my pieces, I used the contemporary floor loom shown in Figure 45. In order to create four layers of cloth, the loom must have at least eight harnesses (see Figure 46), two for each layer of plain woven cloth. The more harnesses you have the greater the capabilities of the multi-layered designs.

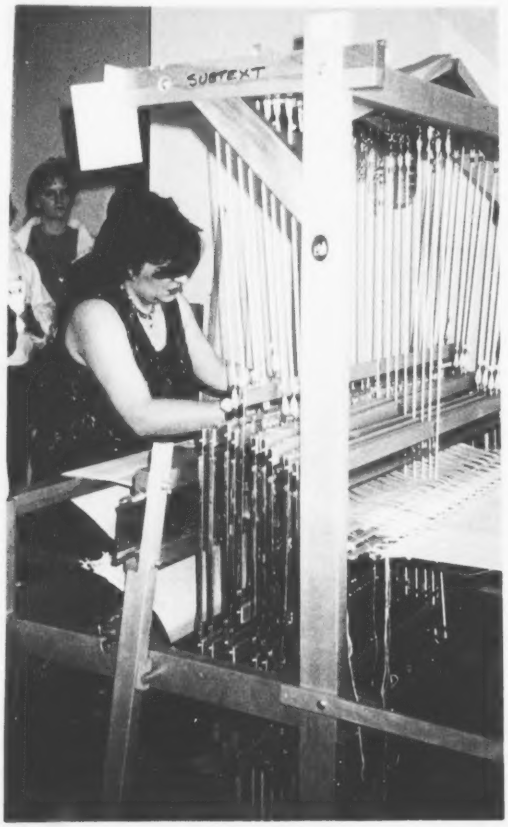


Figure 45. Utilizing eight out of twelve harnesses on a contemporary floor loom (Photo by A. Lambert, 1995).

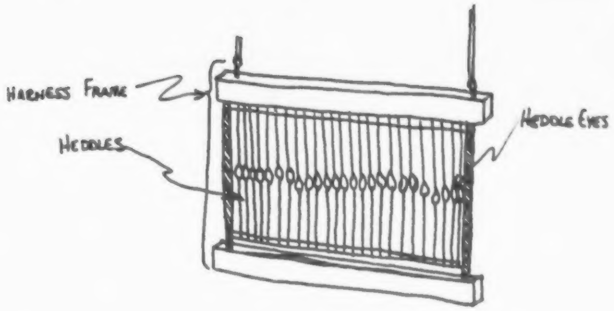


Figure 46. Example of a harness frame that hangs in the centre of the loom (Sketch by J.A. Renzi, 1996).

A double weave begins with two warps, eg. one light over one dark, and two weft elements, one light and one dark for the corresponding warp layers. Each of these warps is threaded on the loom to create a plain weave structure. The following diagram (#47-49) illustrates a cross-section of a double cloth and the crossing of the warp threads. The dots represent the weft threads and the lines represent the warp threads. This process produces two distinct and different coloured layers of cloth simultaneously. When the two warps of a double-cloth are woven separately from one another (Figure 47),

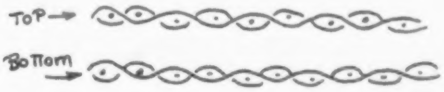


Figure 47. Warp-wise cross-section of a double-weave (Sketch by J.A. Renzi, 1995).

then interchange (Figure 48), the two layers of cloth switch positions and an interchange of colours occurs,

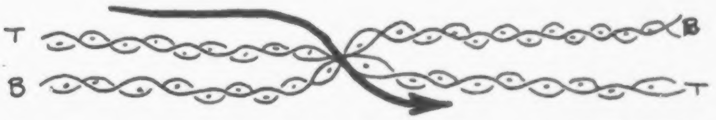


Figure 48. Double-weave warp interchange (Sketch by J.A. Renzi,1995).

If the layers interchange again (Figure 49) and resume their original positions,

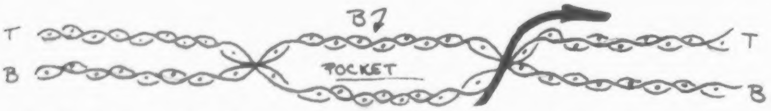


Figure 49. Pocket created from second warp interchange (Sketch by J.A. Renzi, 1995).

a pocket in the fabric is formed. This switch, "provides the means whereby two-colour patterning of almost any degree of complexity can be produced" (Emery, p.156). Such an exchange of coloured warps can be observed in the square motif double cloth (see Figure 50) Acc#970.006.001, and the William Morris textiles (see Figures 51 & 52, Acc# 986.032.001, and Acc# 986.032.002 respectively).

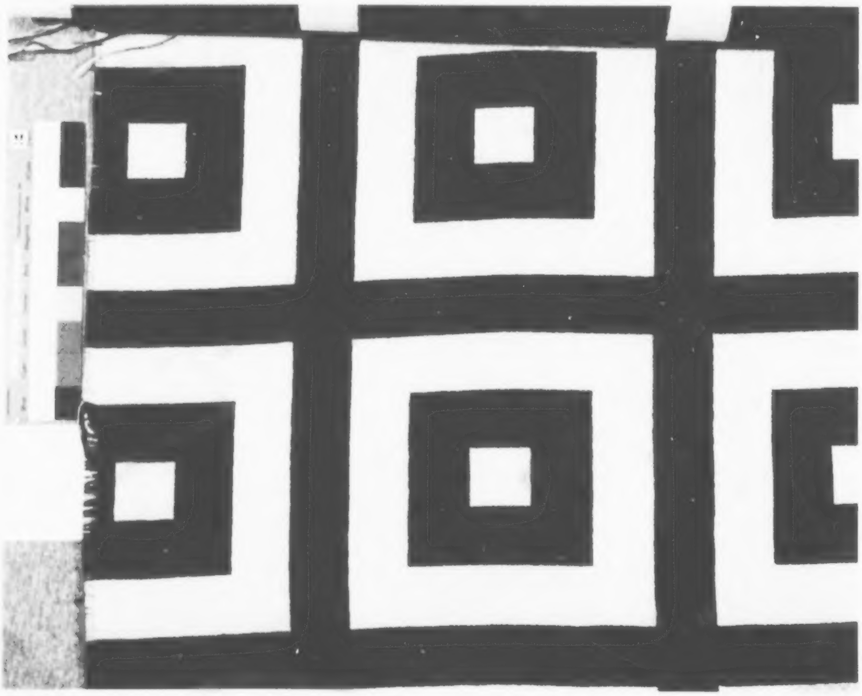


Figure 50. Black and white double cloth Acc#970.6.1 from the U of A, CLTX Collection. The corresponding coloured warps alternate creating a negative motif on the reverse side. Dimensions; L=152cm, W=91.5cm (Photo by J.A. Renzi, 1995).

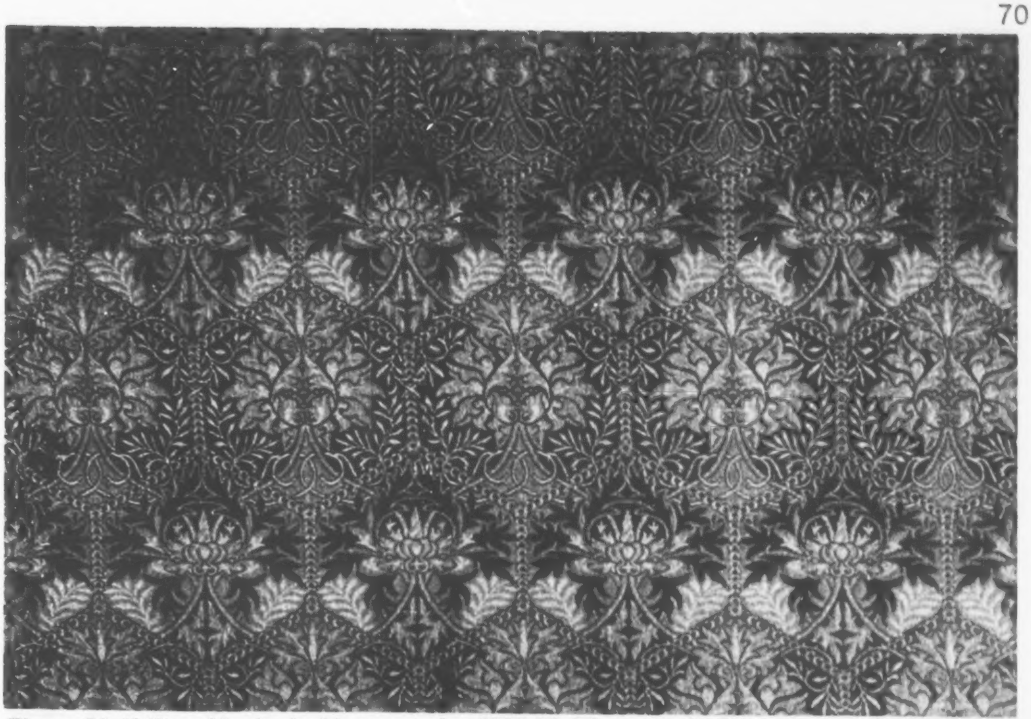


Figure 51. William Morris double weave Acc#986.32.1 from the CLTX Collection. Dimensions; L=236cm, W=127cm (Photo by J.A. Renzi, 1995).

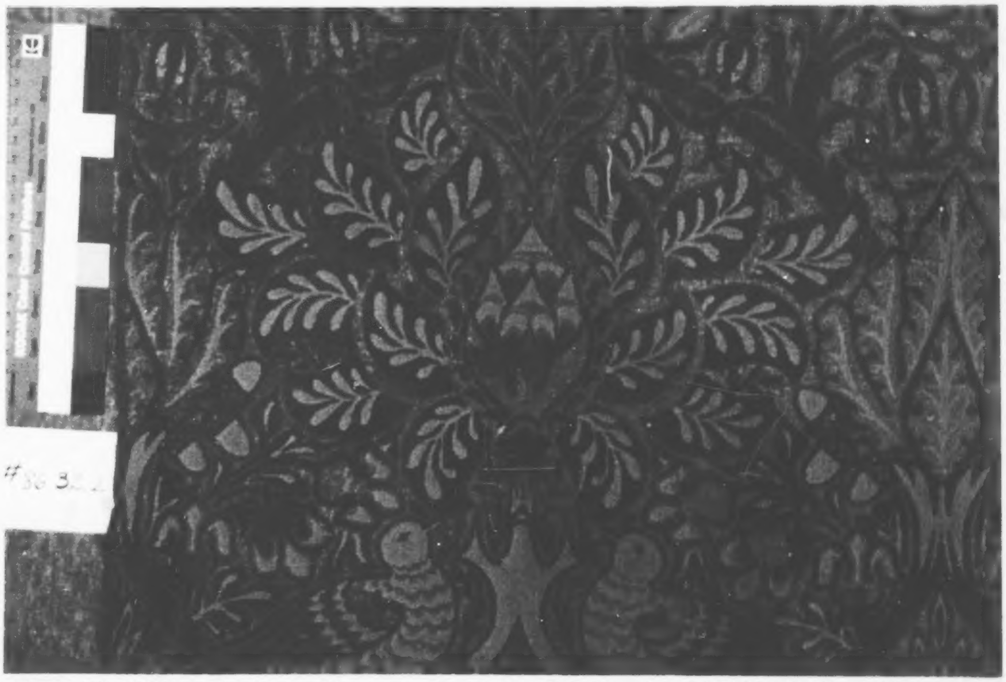


Figure 52. Willaim Morris double weave Acc#986.32.2 from the CLTX Collection. Dimensions; L=161cm, W=88cm (Photo by J.A. Renzi, 1995).

The interchanges between warp threads not only create a pattern but aid in the structural stability of the fabric. When the two warps switch sides they bind together to form one compound fabric. Depending upon the size of the pattern areas, pockets, like those previously mentioned in Figure 49, will be created. The interchange of coloured warps with their corresponding wefts create identical pattern areas on both faces of the cloth. From the basic double weave structure, variations can be created through the ways of connecting the layers. Some of these different variations are as follows;

1) connecting one edge forming a double width weave (as shown previously in Figure 40),

2)

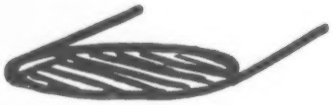


Figure 53. Connecting both edges forming a tubular weave (see also Figure 58, Acc#984.17.7).

3)

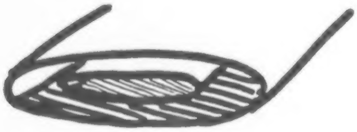


Figure 54. Doubling weave structure #2 making a tube within a tube.

4)

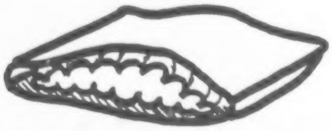


Figure 55. Connecting two layers and placing material in between them, creating a stuffed double weave.

and, 5)

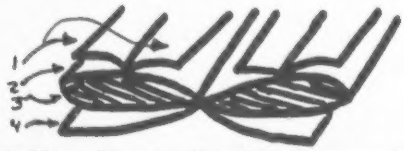


Figure 56. Working with more than two warps as in multi-layer weaves.

As I have illustrated above, when a third warp and corresponding weft is added, a complex triple weave is produced. It not only has a third matching set of warp and weft threads, but a third woven cloth lying between those which form the two faces of the fabric (Figure 57). However, if the third fabric is not woven but floats between, when not interwoven with, the two face layers, it is said to be an 'incomplete triple-cloth' (Figure 58, Acc#984.17.7).

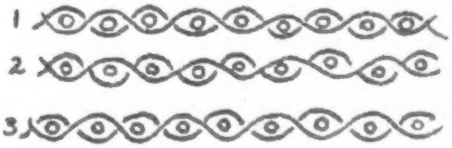


Figure 57. Cross-section diagram of a triple layer weave (Sketch by J.A. Renzi, 1995).

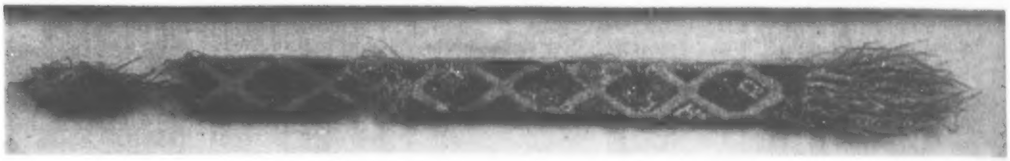


Figure 58. Tubular weave, incomplete triple cloth from Peru, Acc#984.17.7 from the U of A, CLTX Collection. Dimensions; L=42.5cm, W=2.5cm (Photo by J.A. Renzi, 1995).

This structure may also be described as double cloth with a supplementary set of warp threads, but for the purposes of this study, this type of structure will not be discussed.

Once the technical aspects of these weave structures are understood, there is room for invention. For example; by combining a triple weave with a tubular weave, and a double-width weave in varying sequences, depending upon your aesthetic preference, a unique textile form can be developed.

The history, theory, principles, and applications of double-weave technology are outlined and explained by Brostoff (1979), and O'Connor (1991), however; they did not discuss the myriad of possible structures that could be created by combining weft element interchange with warp element interchange. Regensteiner (1986) attempts to touch on this subject but only offers a vague diagram without written explanation. It is precisely this concept that I addressed with my fibre art pieces.

Contemporary Artistic Developments in Handweaving

Although they follow the same basic/traditional technical guidelines, not all handwoven textile artists work the same way or create the same objects. Yet, similarities are discovered when textile artists make statements about personal textile design processes. The following are a few quotes that express the similarities that I share with other artists of handwoven fibre art.

Artists' Perceptions and Processes

Many designers find it difficult to explain their creative methods, and this is exemplified by double-weave artist Sharon Alderman;

> One of my favourite parts of the creative process happens during the weaving of the hangings. I usually put on a warp that is long enough for at least two pieces. The first piece I can see in my head before I sit down to the loom. I have totally planned it out. The second piece is different. I let the warp speak to me about what it can do. It's an odd sensation and difficult to describe really well (Godfrey, p. 38, 1990).

Although she admits to not being able to describe her method, it is easy for me, as a weaver, to identify with Alderman's explanation of utilizing the weave process.

Magdelena Abakanowicz (Hutton, 1975) approaches designing her textile forms intuitively through off-loom techniques. She stated that her imagination thrived on textile materials, allowing her the freedom to create different forms:

> On the surface that I make with threads every square inch differs from

> the next as in the creations of nature. I am interested in constructing an environment for man [sic humans] from my forms, and in the scale of tensions that arise between the various shapes that I place in space" (p. 92).

In their book Beyond Craft: The Art Fabric, Constantine and Larsen (1972) collected and presented a variety of fibre artists' biographies, quotes and images of their works. The most insightful information available to the reader would be some of the quotes received from the artists about their methods. One example, that seems relevant to me as a handweaver, is written by the artist Wojciech Sadley;

> I work on series of problems - constructional and formal. Approaching every problem, I begin by studying the relations between means of expression and constructional factors. Every series is solved in a different way, varying with the emotional and constructional problems interesting me. I use every possible form of developing my concept by drawing, painting, modelling (p. 236).

Another important artistic consideration on the topic of weave structure, in accordance with my methodological ideas, was made by the artist Herman Scholten; "The way in which the threads are connected and the choice of material determine the aspect of the structure" (Constantine & Larsen, p.248). Scholten also "explores and itemizes the possibilities within a technique" (p.257) through his many sketches which aid in his design idea development, another similarity to my personal visualization process.

During an interview, handweaver Peter Collingwood stated that being inventive when weaving is just as or more important than being creative; "To justify myself as a handweaver, I feel that I have to be able to do something a machine can't" (Patrick & Irwin, p.49). Collingwood is an expert in complex weave structures and their techniques yet he describes his method in this way;

> When designing I never start with a blank sheet of paper and some wonderfully inspired design and then ask how long can I weave it? Rather, I always start with a technique, do a long sample and see what the technique will produce. I try to exploit what a technique will give me rather than impose a design on a technique. If a technique automatically

> gives little square blocks, then I try to see what can be done with little square blocks. If a weave automatically gives diagonal lines, then I see what I can do with diagonal lines. It's one of many approaches, but it's the only way I know how to do things (p. 48).

Collingwood's approach is technically different from the way I work but his recognition and documentation of how he works, aided in my search for a methodology which combined both the technical and the creative.

My search for personal methodology then led me to double weaver Sandra Brownlee-Ramsdale (1986), who works intuitively at the loom. She explains her method in the following quote;

> I have worked with woven imagery since 1979. This exploration of woven imagery has encouraged me to develop a manner of working similar to drawing - ideas and images emerge *during the weaving process* [italics added] as it progresses row by row (p. 147).

Brownlee-Ramsdale, although a two-dimensional weaver, clearly describes one of the main factors that I utilize in the creation of my three-dimensional weavings; a spontaneous evolution of ideas. She states that "decisions are made about how to make each shed quickly and intuitively as lines, dots, shapes, and patterns are formed while the work progresses row by row" (London, p.33). Discoveries are made at the loom and not prior to sitting at it. It is true that a certain degree of skill is necessary for a weaver to work in this manner, moreover; I have found myself recreating designs spontaneously, after the initial tie-on of the warp.

Inherent Material Characteristics

The fibre of preference used for my handwoven three-dimensional forms is ramie and, unlike cotton and linen, is relatively unknown. The characteristics of ramie fibres lend themselves to the desired properties of my finished pieces. High crystallinity and lustre offer crispness, strength, and a shiny appearance. Yet, the degumming processes involved in ramie production relax the fibres and make them less brittle, therefore; depending upon how much gum is removed, this process gives the finished cloth a softer hand. These characteristics are described more fully in the following paragraphs.

Ramie Fibre

The bast fibre ramie also known as; rhea, grasscloth, or China grass, is indigenous to China, but will also grow in countries that have a hot humid climate. Cultivation of the ramie plant Boehmeria Nivea can be traced back several thousand years to 5000 BC, when Egyptian mummy bundles were found to be wrapped in ramie fabric (Lewin & Pearce, 1985). There is a limited amount of commercial and lay information written on the subject of ramie. An unknown fibre in the lay community, many people often mistake ramie for a synthetic cellulosic such as rayon.

Ramie has many distinct conservational advantages that set it apart from other natural fibres. One of the strongest cellulosic fibres known, ramie increases its strength when wet and has a very high resistance to shrinkage, rotting, mildew, insects and microorganisms (Hollen, Saddler, et al., 1988). The fibres are difficult to dye, but have good absorbency and are naturally white in colour with a high lustre, eliminating the need to bleach or mercerize the fibres. These processes are potentially hazardous to the environment and if any of these chemicals remain in the fibres, they can become conservational hazards.

The main use of ramie is in apparel as a blend with other fibres, the most popular being cotton, acrylic and polyester. It can be made into a 100% ramie fabric that closely resembles linen, but disadvantages such as poor elasticity and colour retention, and expensive degumming processes, have minimized its production. The more gum and waxes that are removed during processing, the more flexible or "nonbrittle" the fibres become (Matthews, 1947). Laboratory experiments by Zheng, Zhang, and Luo (1988) have discovered new, inexpensive methods of degumming ramie that may have an impact on the amount of ramie produced in the future.

Chemistry & Properties

Ramie is a highly cellulosic fibre that is composed of 68.6% cellulose and 13.1% hemi-cellulose and almost no lignin. Of the natural cellulosics, ramie has the highest degrees of polymerization and birefringence (Cheek & Roussel, 1989). Ramie's high strength is due to its highly ordered fibre structure. The degree of crystallinity of ramie, based on x-ray methods, is approximately 70-74% when dry, and 54% when wet (Lewin & Pearce, 1985). This accounts for the stiffness and brittleness of the fibres as well as high tenacity, chemical resistance, and lustre.

Once the fibres have been decorticated and degummed, crystallinity increases but the orientation of the crystallites decreases. Scientists have attributed this to the swelling action of the reagents used in the degumming process (Cheek & Roussel, 1989). By lowering the orientation, the elongation potential of ramie may be increased. The ramie fibres themselves are long, ranging up to 150+ cm., and have a very fine diameter of ~0.06-0.904 mm. This fine diameter is what may differentiate ramie and flax under a microscope more than any other characteristic. Ramie (see Figure 59) has been described as being very close in physical appearance to flax (see Figure 60) except for the regularly occurring nodes on flax.

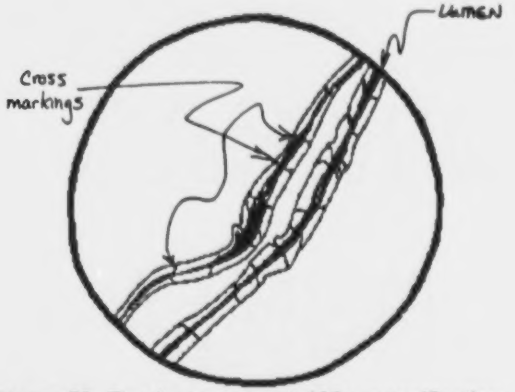


Figure 59. Ramie as seen at 400x magnification, mounted in distilled water (Sketch by J.A. Renzi, 1995).

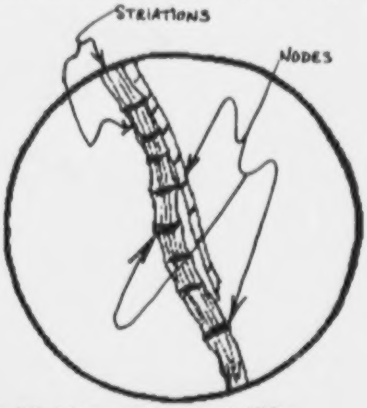


Figure 60. Linen as seen at 400x magnification, mounted in distilled water (Sketch by J.A. Renzi, 1995).

The surface of ramie taken from photomicrographs by Olivotto (1995) can be seen in Figure 61. Ramie appears smooth with an irregularly collapsed lumen, but according to Matthews, ramie may be flat and ribbonlike but never twisted like cotton (see Figure 62).

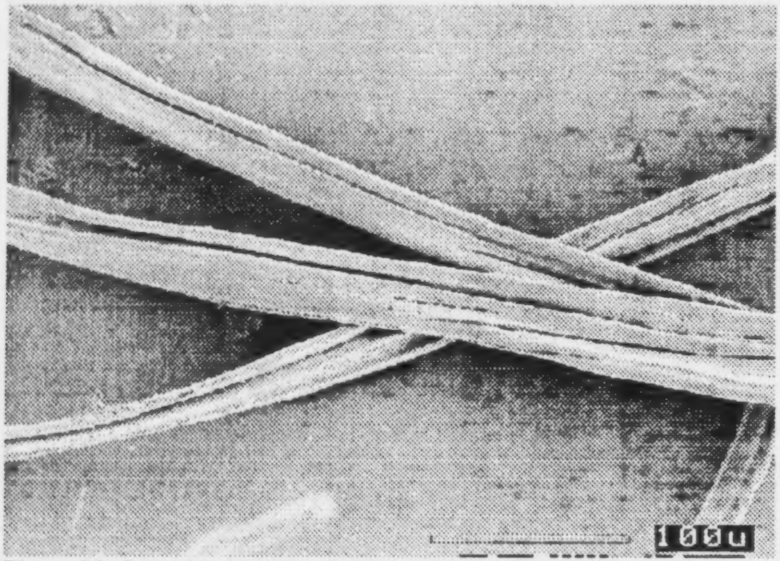


Figure 61. Scanning electron photomicrograph of ramie fibres. (Y. Olivotto, 1995).

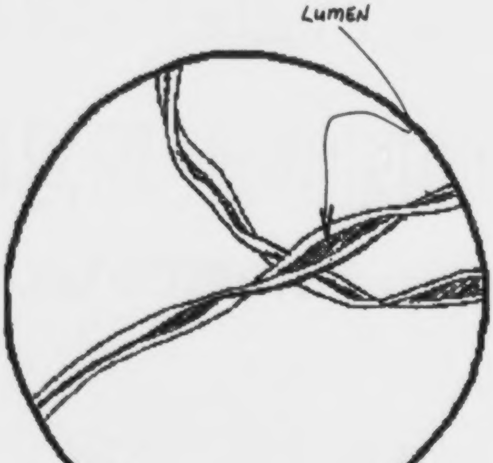


Figure 62. Cotton as seen at 400x magnification, mounted in distilled water. (J.A. Renzi, 1995).

5. CREATION OF THE THREE-DIMENSIONAL, MULTI-LAYERED FORMS

The visual and literary influences I reviewed in chapter four were combined with the creative processes I recorded in this chapter. The interfusing of the theoretical with my personal design concepts implemented the thesis metaphor I developed in chapter three. The following processual study of the creation of my pieces is comprised of excerpts taken from my sketches, journal entries, and photographs composed during the production of my fibre art works. How decisions were made and the technical difficulties encountered during this process were discussed and recorded mostly through sketch development and technical formulae. However, the separate stages described in this chapter are part of a recursive, not linear, process - they may repeatedly occur within the same design process.

Personal Process

My personal process is a documentation and exploration of how my three-dimensional, multi-layered woven forms developed. I have divided this process into two sections; the visualization process, and the intuitive process. The development of many of my handwoven fibre art design ideas began with preliminary sketches. By layering these ideas, I effectively integrated the elements needed to produce some original designs. I have collected most of these sketches and they can be found in Appendix A and discussed in the following section entitled "visualization process".

Visualization Process: Sketches

The majority of my preliminary design time was spent sketching and planning design ideas. Whenever I was inspired, and on whatever paper I had available, such as torn bits of lined note paper, I drafted my concepts. Due to this abundance of scrap paper, I have reproduced some of my original, preliminary sketches by photocopying. These sketch reproductions can be found in Appendix A. The more interesting designs that developed from these rough sketches were then enlarged (Appendix B) with analyses made as to possible production techniques.

Once this stage was reached, the next step in my visualization process was problem solving. The more problems solved during the design stage, prior to the actual handweaving process, the quicker the completion of finished product. My original designs were intended as human-sized portable environments to be installed within architectural spaces. During my handweaving process these original design concepts proved too difficult to accomplish and due to technical limitations I had to reduce the scale of my pieces.

I originally decided to create models of my design ideas, prior to handweaving, using cotton muslin on the sewing machine. Producing the three-dimensional designs in this manner, however, was not conducive to the visualization process. I realized that changing the overall intent and structure of my original designs through machine stitching would be antithesis to my design objectives. Therefore, I worked on creating technical solutions to my structural problems using weaving equations and personal problem solving procedures. Once these decisions were reached I began my intuitive process of creating my designs on the loom.

Conservation concerns

One major design influence was how I could incorporate conservational characteristics into my structures. When discussing the conservation of contemporary fiber art pieces, the topic of inherent vice is inferred. Inherent vice refers to the natural life cycle of textile materials which are fused with other materials that affect it. For example, a piece of silk organza penetrated throughout its entirety with steel straight pins and then coated with urethane will eventually decompose. But, in order to conserve this art piece do we disassemble it? No, because these inherent "vices" are what create the piece.

As long as artists such as myself are aware of the vices that they work with, the destructive quality of various materials can be controlled or encouraged, depending upon the desired outcome.

As a textile designer with conservation training, I am interested in the possible inherent virtues that could be designed into a work of fibre art. In contrast to inherent vice, inherent virtue refers to the built-in conservational characteristics that enhance a textile's longevity and ease of care while maintaining it's artistic integrity. I have become aware of how I might create, finish, exhibit, care for and store my textile art pieces so that they follow conservation guidelines and my personal aesthetic. Designing a woven textile is time consuming and sometimes monotonous, however; creating a completely new piece of fibre art that will survive longer than I will, through image or physical structure is an important and exciting concept. Researching textile characteristics and how other materials affect them has increased my curiosity towards the fibre medium.

When exhibiting my work I have become more concerned with environmental effects, stresses caused by hanging, and the dimensional changes that may occur from hanging and cleaning my art pieces. This awareness has made me more sensitive to the materials I work with and also to how I work. Whether or not it is necessary to apply flame retardant to textiles intended for public display in a building has also become an important factor during the planning of a work. By maintaining this awareness, I can enhance the inherent "virtues" existing within my own art.

Computer-Aided Design

Once I determined the structures of my preliminary textile designs, I drafted my solutions into the computer (see Figure 63). I conducted an independent study which focused on programs developed for IBM compatible computers. As an advanced weaver, I chose a program with complex weave capabilities, an extensive colour palette and graphics, and multi-edit functions.

The documentation process was conducted using the Patternland Weave Publisher 2.1 software program. This program allowed for on-screen, two-dimensional drafting of the warp threading, tie-up, and treadling sequences. Preferential colours could be selected and modified in accordance to the weave design. I drafted the basic weave structure of a quadruple-layered weave into the computer and proceeded to work with variations of this structure. During the course of this process however, I discovered some limitations existing within the program especially when dealing with drafting certain handweaving techniques. For example, if I desired to press down two treadles at once during production, or throw the weft halfway and back, the program would not allow it. For further discussion about possible future research solutions to limitations such as this, refer to chapter six.

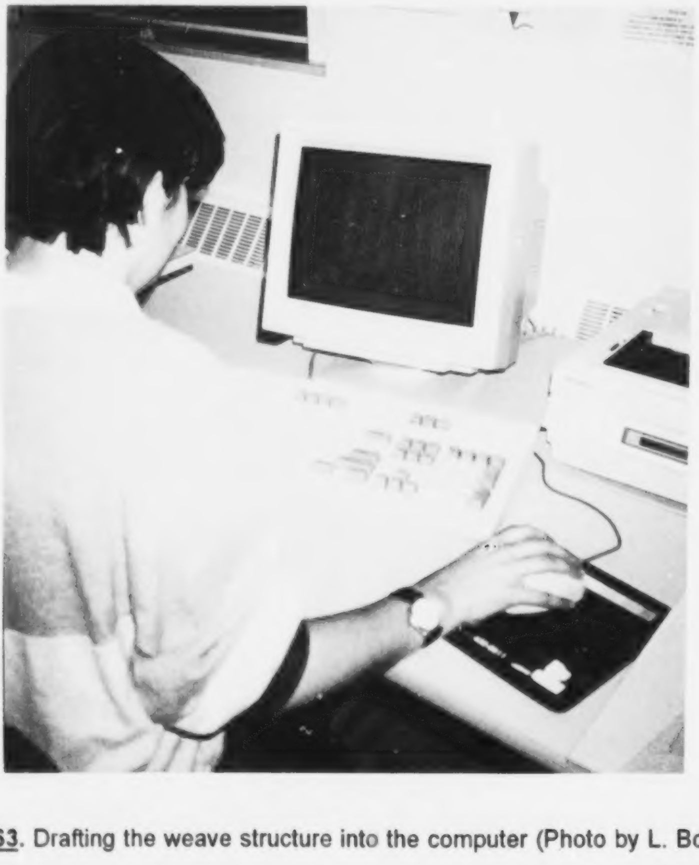


Figure 63. Drafting the weave structure into the computer (Photo by L. Boone, 1995).

Preparation of the Warp

In order to calculate the correct yarn requirement for a meter^2, multi-layer textile, I began using the following basic formulae taken from Tidball (1976), with the exception of my addition of calculation #2, due to the non-existence of a multi-layered/ double weave formula:

1) no. of ends per inch x width of finished piece x length in yards = warp thread yardage, **20 epi x 39" x 3yds = 2340 yards of warp,**

2) thread yardage x no. of layers, **2340 x 4 = 9360,**

3) thread yardage ÷ no. of yards per lb. = yarn poundage for warp, **9360 ÷ 2400 = 3.9 lbs,**

4) yarn poundage x 2 = warp and weft requirement for any balanced weave or warp (p.15), **3.9lbs x 2 = 7.8 lbs.**

The rest of the preparatory work included; tie-on, threading, tie-up, winding-on, and sleying the reed. All of these processes were documented in my journal excerpts, photographs, and post-production weave drafts.

Intuitive Process: Handweaving

After the visualization process was completed, I selected those ideas that would best represent the design I wished to work with. However, the design plan was always left open for innovation. During the weaving process novel ideas emerged and at times were incorporated into the original design. After the design had been chosen, the next step to creating the textile was to check the equipment and make sure it was ready, then to wind the warp (see Figure 66).

The following italicized excerpts and photographs taken from my personal journal, kept during the weaving process, aid in presenting to the reader part of my intuitive process:

Thursday, July 6, 1995

I began this project a week ago (Monday) - the extended time was due to the shortage of heddles on the loom itself. After this problem was remedied, the *threading of the warp was completed on Friday (June 30). Once the warp was wound onto the warp beam* (Figure 64), and *a preliminary tie-on was made* (Figure 65), *I proceeded to wind the warp onto the front take-up beam and then back onto the warp beam, in order to even out the tension. This task proved necessary as the ramie threads had begun to knot and twist together due to their long fibrils. Threads were separated individually by hand for fear of breakage.*

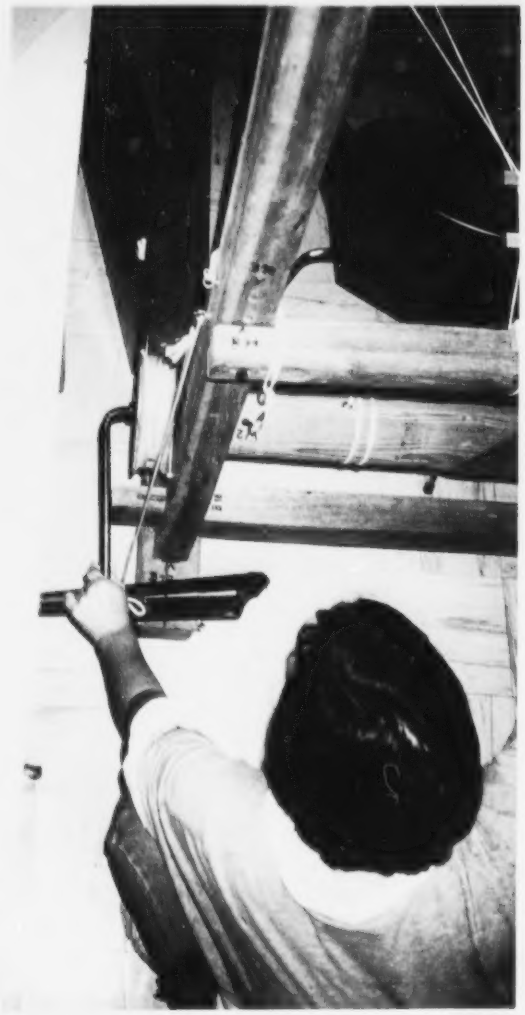


***Figure 64**. Winding the warp onto the warp beam (Photo by L. Boone, 1995).*

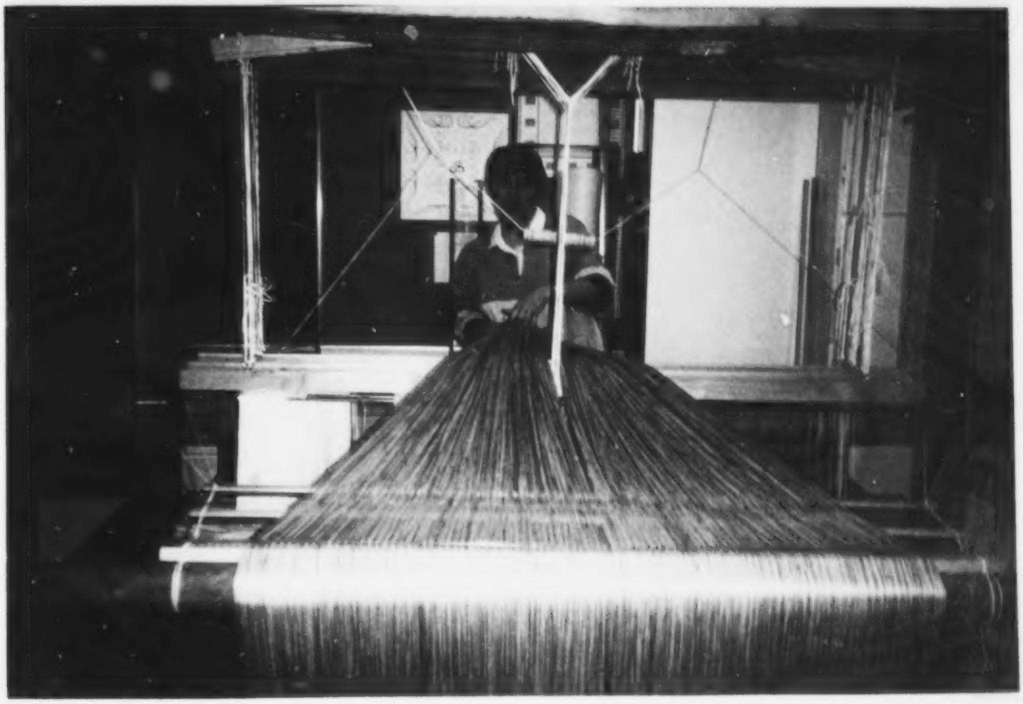


Figure 65. *Pulling the warp at the front of the loom in order to tie-up to the take-up beam (Photo by L. Boone, 1995).*

E.P.I. (Ends Per Inch) - The warp was calculated and wound at 20 epi to be 40" wide. A ten dent reed was used with 8 ends per dent (epd).

(2 epd x 4 layers = 8 epd)

But, the reed proved too rusty to use and the warp was not extending to its calculated width, leading me to switch to a 12 dent reed with 8,4,4,8... ends per dent giving me a unique spacing structure.

On Wednesday, I rewound the warp onto the warp beam (Figure 66) and sprayed the warp with water in order to keep the threads from breaking and sticking to one another. Unfortunately, when wet, the fibrils twisted and stuck together really badly. (This was of course discovered later). As the selvedge tension always loosens during the weaving process, I tied these ends tighter than the rest. (I'll probably resley the ends closer together).

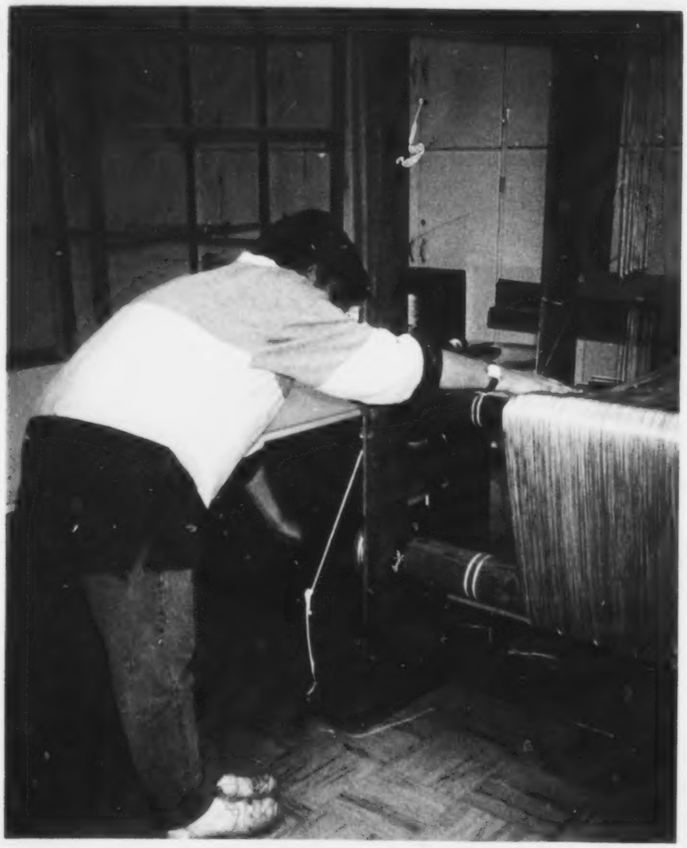


***Figure 66**. Rewinding the warp onto the warp beam (Photo by L. Boone, 1995).*

It's now time to tie-up the treadles. I am trying to decide on a proper weaving sequence for the four layers. I'm tempted not to follow a pre-set design but allow the loom to determine the structural outcome of this piece. But, I still need a starting point. Which layer will go on top?... I have 4. One is an open gauze layer, one is blue-grey, and the other two are white.

The gauze layer is definitely my main concentration structure around which the other three will develop. The 2 white layers will work as balance in the overall composition. And the blue will counter the gauze. I have eight harnesses and ten treadles. Think of something flat and then how it would open up into space. The gauze layer will have to be most effected by gravity since it will be a flimsy fabric. The gauze and the blue layers will be perpendicular and the 2 white layers parallel. I've decided to do a larger version of the small piece that I have entitled "Pagoda".

Friday, July 7, 1995

Everything went wrong, my calculations were off, and the warp is not as wide as I thought.

Saturday, July 8, 1995

Even worse today, the lights in the room I'm working in all burnt out or something, and I've decided to resley the reed (again).

Wednesday, July 12, 1995

I finally got someone to fix the lights (twice!).

I resleyed the warp into the 10 dent reed after cleaning most of the rust from it, with 7 epd due to the gauze layer. (If it was a reg. layer it would be 8 epd, making the piece 20 epi).

The warp is very fuzzy and tends to keep sticking. I've decided not to spray it with water (for strength). Since it has high tensile strength I am relying on this property to prevent breakage.

In order to get a closed horizontal edge, I am going to weave the layers out of order for approximately 1/2". Which means changing the tie-up. I had problems with breakage already while weaving the top layer.

Thursday, July 20, 1995

I weave approximately 1 inch per hour when weaving more than 2 layers simultaneously. I've passed the halfway point and estimate to be completed by tomorrow (Friday). I may have only enough warp for one piece, the colour of this piece will determine the next one somehow (Stick with neutrals?).

So far it has taken three weeks to produce 1 piece. The main problem lay in resleying of the rusty reeds and the stickiness of the fibres. If I wish to have 4 or 5 pieces for this thesis I may not be ready for the October deadline. So far my inspirations have included, paper folding, architecture, and fabric forms (such as tents, etc...)

Table 1. *My warp tie-up for Pagoda and Windowz '95 was as follows:*

HARNESS	WARP
1	gauze
2	white 1
3	blue
4	white 1
5	blue
6	white 2
7	white 2
8	gauze

Tuesday, August 22, 1995

Finishing the edges of "Pagoda" has taken a long time (2-3 weeks to be exact). Decided to create another piece out of the remaining warp. Due to the drastic variation in tension by the end of the previous piece, I had to re-tie the warp onto the front take-up beam. The idea for the next piece is "windows and shutters", it will be 29" wide x 12" long (see Figure 67). The design will be woven sideways.

Friday, August 25, 1995

Window idea derived from gauze layer, decided to utilize sheer quality. Change in tension during weave process was remedied by weaving in thicker yarns and then undoing these yarns once the piece was completed and cut off the loom. The main idea of this piece is to echo architecture. Possibly hang piece from architectural mouldings. The layering of the shutters is to create three-dimensional depth in contrast to the flat, central gauze area.

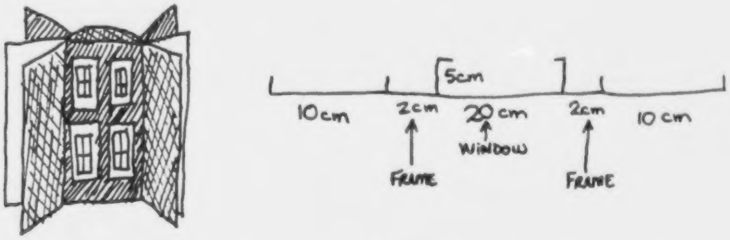


__Figure 67__. Preliminary sketch and measurements of "Windowz '95" piece (Sketch by J.A Renzi, 1995).

Finishing

After the textiles were completed and the warp threads cut from the loom, the non-selvedge edges required finishing. I decided to do a basic braided edge. This was accomplished by taking four warp ends and weaving the first two ends under the second two ends, and so forth (see Figure 68). I did this finishing technique in two's because of the fine size of the warp threads combined with the extensive length of the unfinished edges. For the piece entitled "Pagoda", it took approximately forty-eight to sixty hours to hand-finish all of the edges.

Although the finishing tension was kept tight, the yarns did not hold their position and began to slip. Machine stitching was necessary because the crisp nature and smooth texture of the ramie yarn couldn't aid in retaining the braided structure. Following the hand braiding of the edges, the ends were fixed in place with machine stitching using 100% cotton thread. Apart from stabilizing the finishing, there was no sewing involved in the production of these pieces.

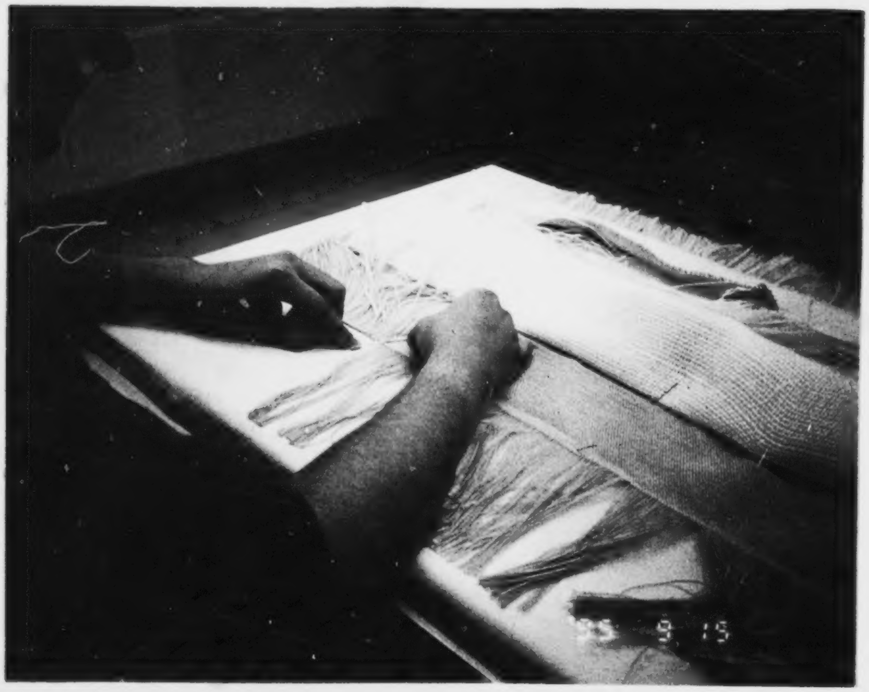


Figure 68. Finishing the edges by hand braiding (Photo by A. Lambert, 1995).

Documentation: Completed three-dimensional, multi-layered forms

My completed weavings were documented on film, their weave structures and drafts executed on the computer. This section, along with the photographic images of my weavings, presents my technical and personal evaluations of the five pieces I produced. The technical descriptions illustrate my placement of the warp and weft threads during the creation of the three-dimensional textile forms.

The handweaving process was difficult to illustrate due to the three-dimensionality of the structures. I included various representations of my weave process to aid those unfamiliar with the process. I used arrowheads to guide the viewer along the path that I took my weft threads. I also drew different views to illustrate either warp created or weft created structures. As a lefthanded artist I prefer to weave from left to right. Therefore, the majority of my computer drafts read from left to right and my technical drawings place the starting position of the weft at the left selvedge.

For the computer drafts, I used two different threading possibilities. Both threadings yield the same results. The four colours used refer to the four different warp layers and not the actual warp thread colours.

Textiles #1, #2, and #3 were all produced from the same cotton and linen quadruple-cloth warp. Textiles #4, and #5 were produced from the same white and pewter grey coloured ramie quadruple-cloth warp.

Textile #1.

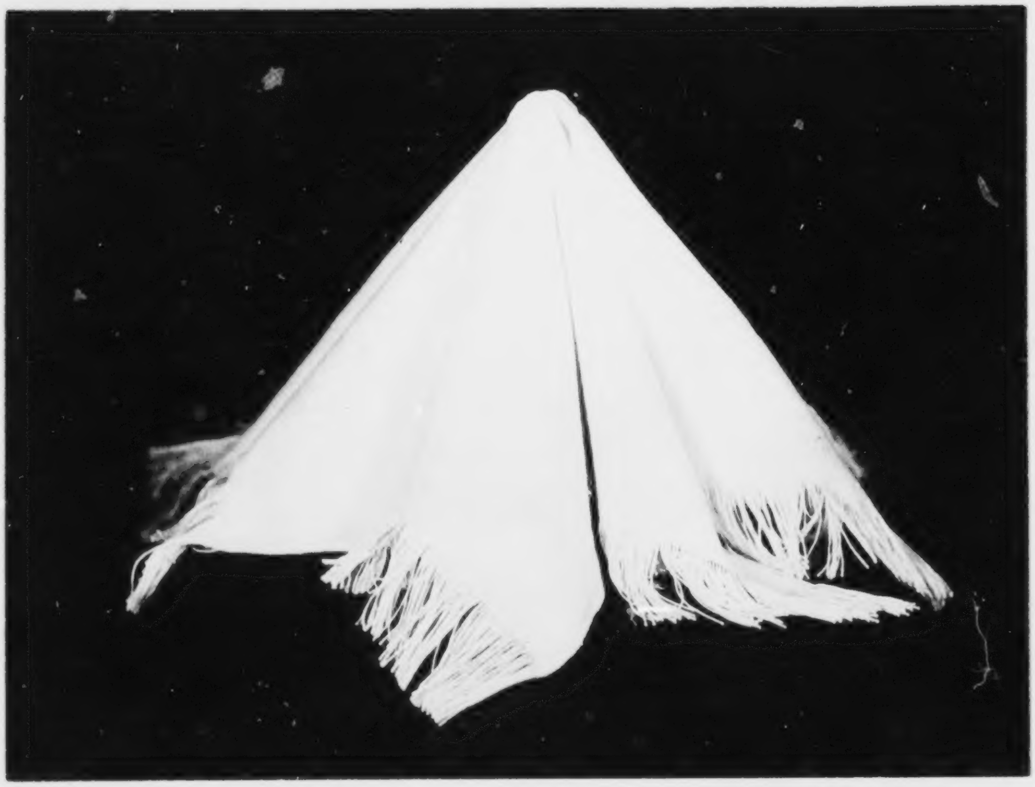


Figure 69. Installation possibility I of Textile #1 demonstrates my open-ended design concept. Dimensions; 16" x 16" x 12" (Photo by J.A. Renzi, 1996).

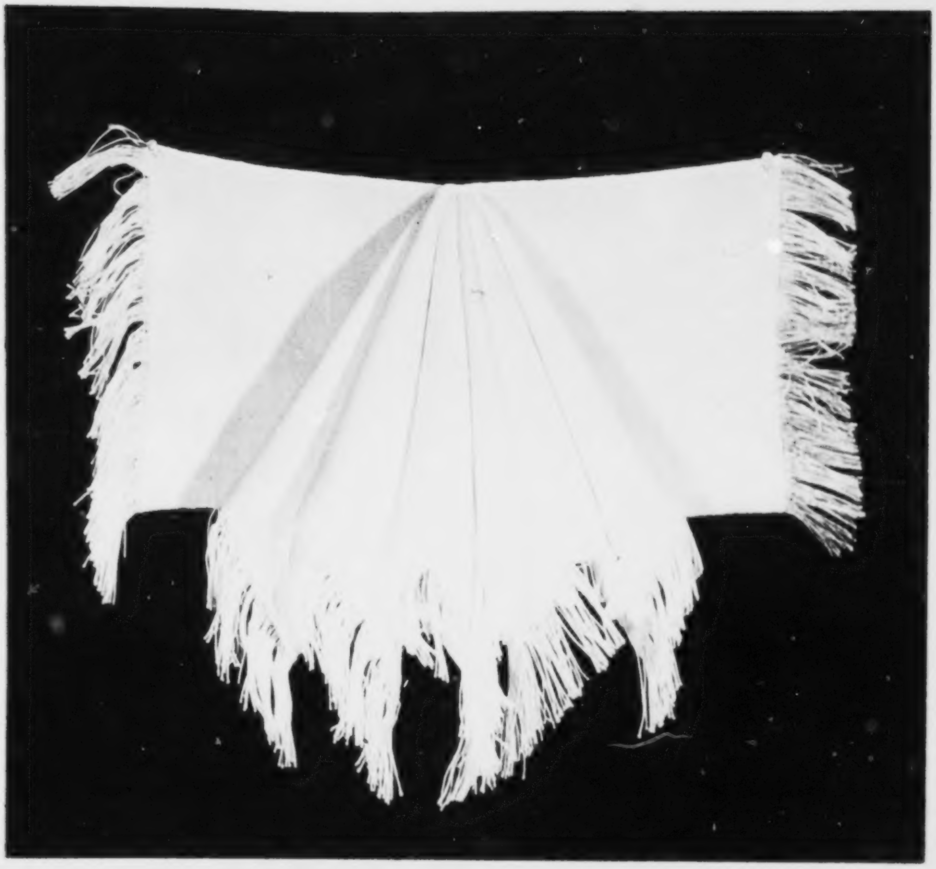


Figure 70. Installation possibility II of Textile #1 (Photo by J.A. Renzi, 1996).

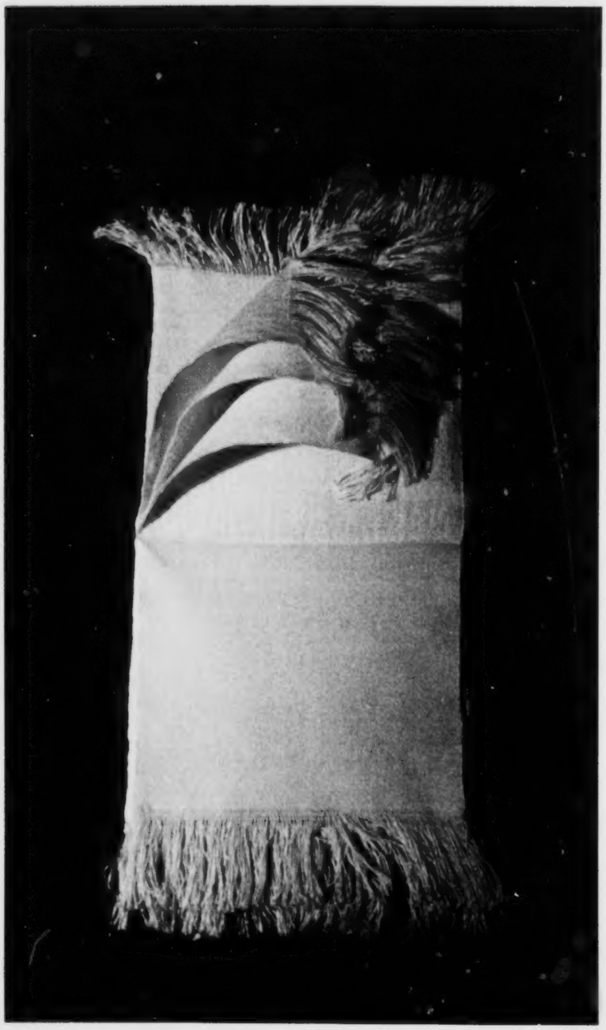


Figure 71. Installation possibility III of Textile #1 (Photo by J.A. Renzi, 1996).

Technical Description:

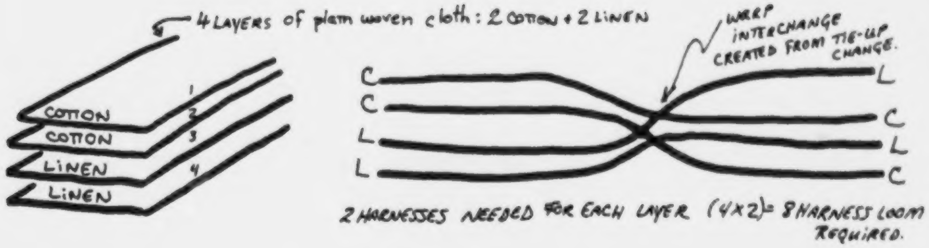

4 LAYERS of plain woven cloth: 2 COTTON + 2 LINEN
COTTON
COTTON
LINEN
LINEN
1
2
3
4
WARP INTERCHANGE CREATED FROM TIE-UP CHANGE.
C
C
L
L
L
C
L
C
2 HARNESSES NEEDED FOR EACH LAYER (4X2)= 8 HARNESS LOOM REQUIRED.

Figure 72. Illustrations representing the warp interchange made during my intuitive process of handweaving Textile #1 (Sketches by J.A. Renzi, 1996).

Personal Evaluation:

The design of Textile #1 is simplistic in construction yet open to many complex "post-loom" possibilities. I drafted Textile #1 using the basic quadruple-layered weave draft shown in Figure 8 with one central warp interchange (see Figure 73). The primary focus of this design was not only the construction but also the variations of form that can be achieved after production.

My design follows a basic warp manipulation concept that started with four warps, two cotton and two linen that I threaded onto an eight-harness loom. Once at the loom, I proceeded to develop my design ideas by allowing the "intuitive"handweaving process to guide my decisions.

I originally intended Textile #1 as a sample to illustrate the kind of structures that I utilized. However, what started out as a simple explanatory device for the double-weave technique has become a source of inspiration for developing three-dimensional textile forms from the simplest of structures.

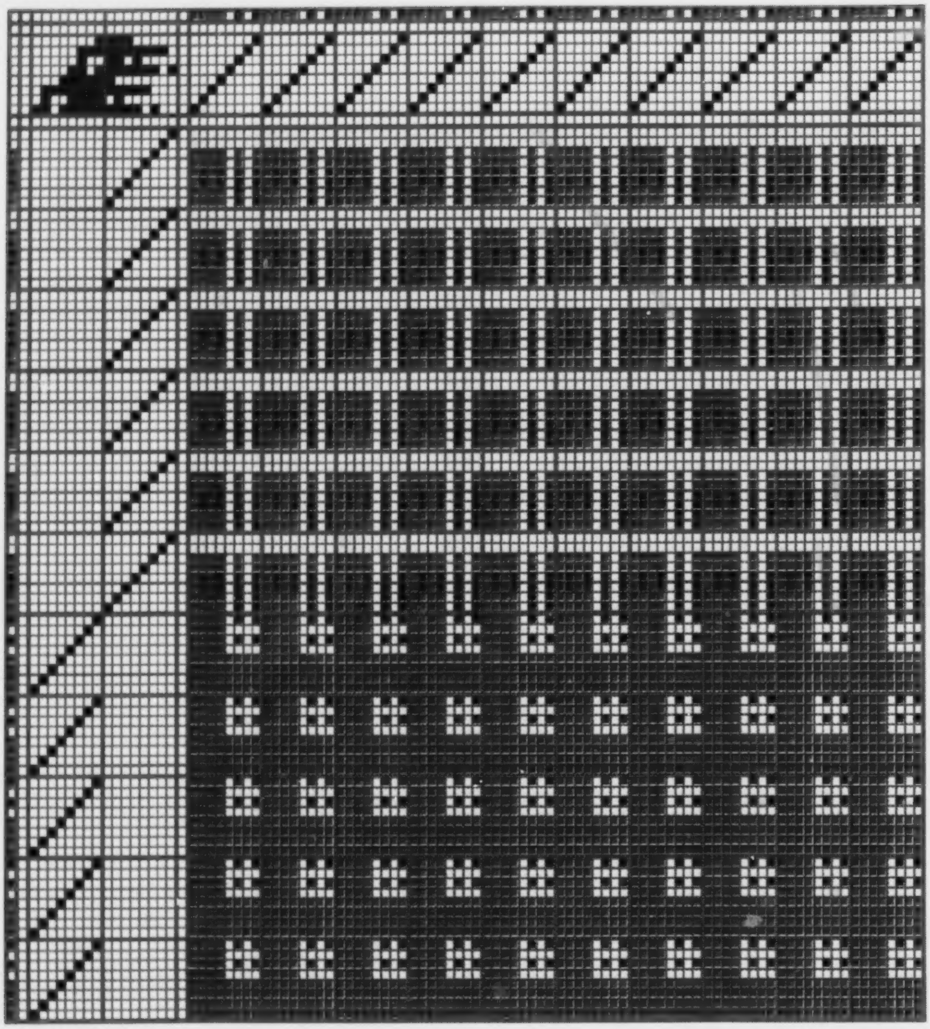


Figure 73. Quadruple-layer weave draft of the warp interchange that occurred in Textile#1. (Drafted by J.A. Renzi from Patternland Weave Publisher 2.1 [Computer software], 1991, Plainfield, Vermont: Maple Hill Software).

Textile #2.

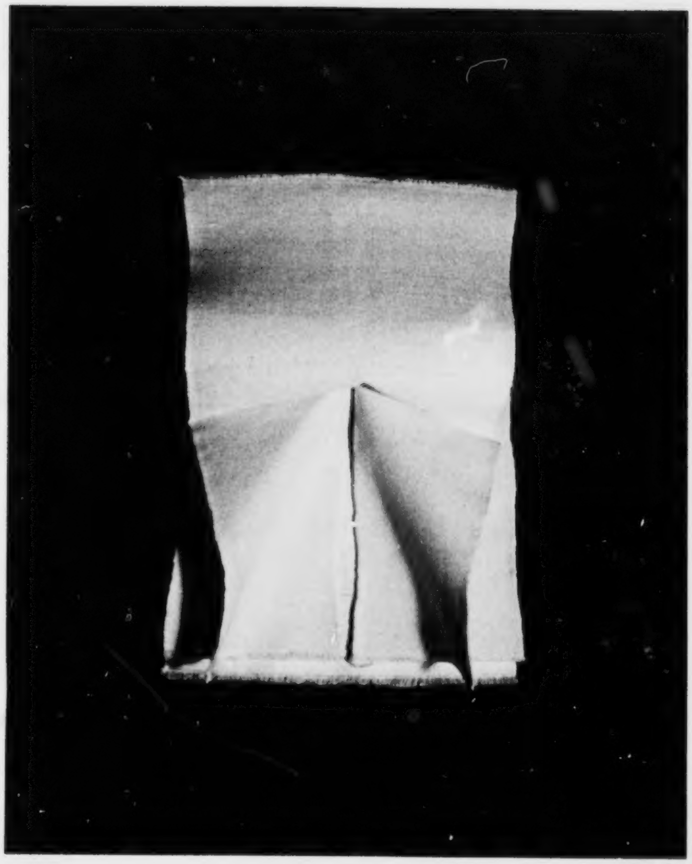


Figure 74. Form variation I of Textile #2 derived by combining a double-layered weave technique with a quadruple-layered weave structure, 9" x 9" x 8.5" (Photo by J.A. Renzi, 1996).

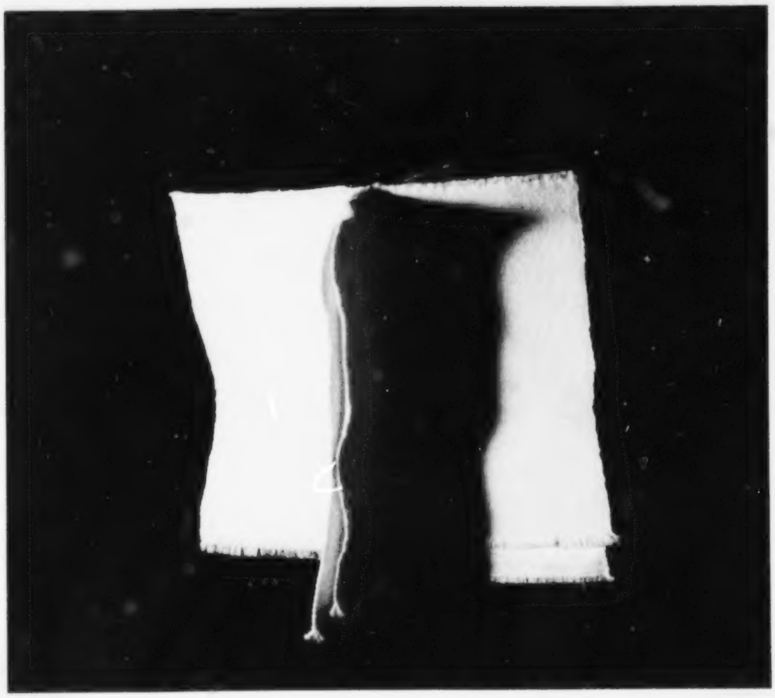


Figure 75. Form variation II of Textile #2 (Photo by J.A. Renzi, 1996).

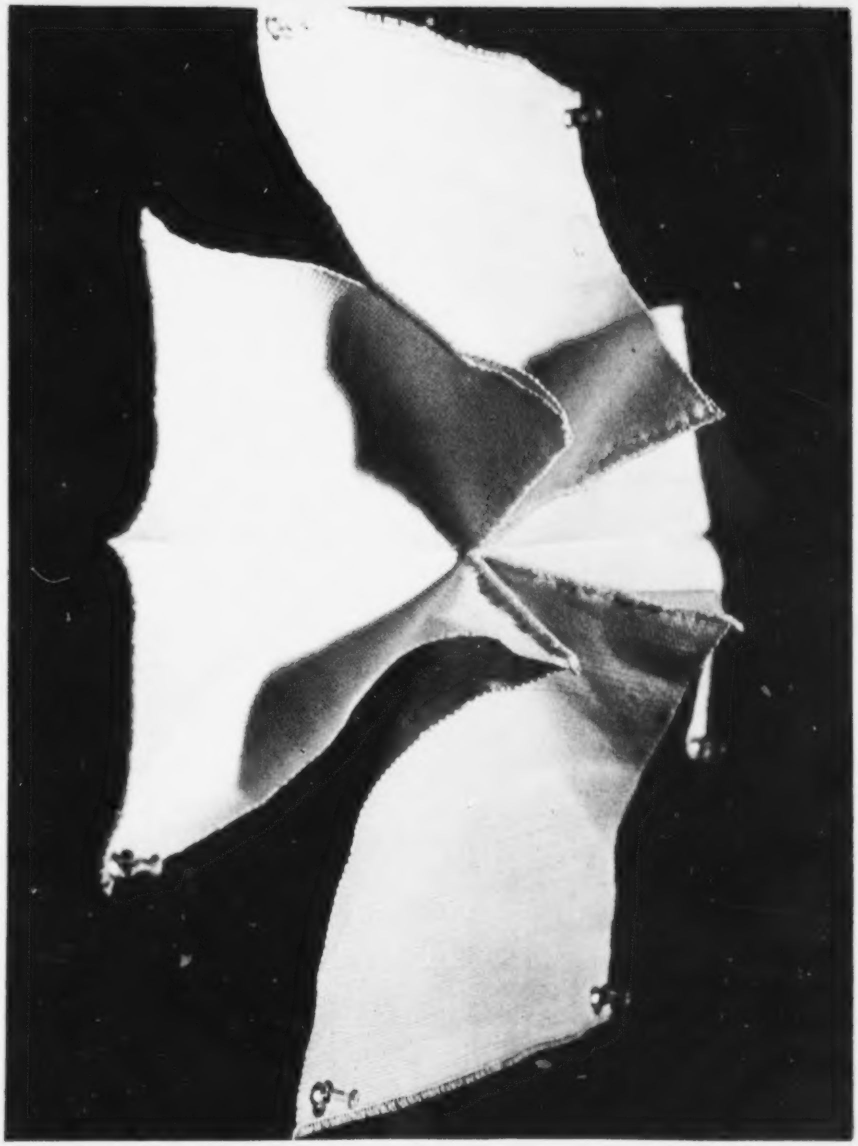


Figure 76. Form variation III of Textile #2 illustrating the perpendicular warps created simultaneously during the weaving process(Photo by J.A. Renzi, 1996).

Technical Description:

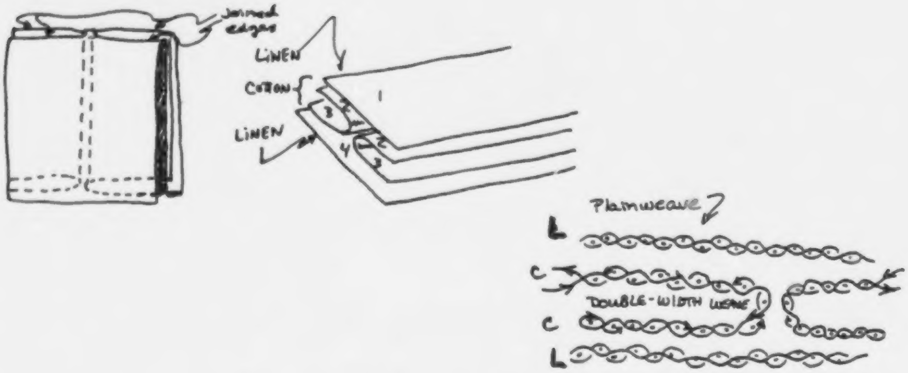


Figure 77. I created the above textile structure by hand manipulating the path of the weft threads (Sketch by J.A. Renzi, 1996).

Personal Evaluation:

I derived the design idea for Textile #2 from a preliminary drawing found in Appendix B (see Figure 96). As mentioned earlier, my original design was intended as a human-sized installation piece. I chose to create this textile form solely based on the complexity of its structure. I desired to solve the design problem I created: joining the two centre layers in the middle instead of at the selvedges in order to create two double-width cloths simultaneously.

There was only one hurdle during the production of this piece, the fact that I was not able see what I was doing. The cotton double cloths being created were lying between two linen cloths being created at the same time. As the weaving progressed, I had to cease production a number of times to check underneath the warp and in between the warp layers to make sure I was not making any major mistakes (eg. missing the shed entirely and creating long floats).

The linen thread that I used was quite old and the selvedge warp ends broke quite a bit. I often sprayed the warp with water during the production of this piece in order to strengthen the linen. The final structural problem that I encountered was how to join the top edges of the piece to create four woven seams. I decided to do a plain weave structure which would join the top layer edge to the top two double-cloth edges, and the bottom layer edge to the bottom two double-cloth edges. These edges were stitched, after the piece was removed from the loom, to prevent the threads from unravelling.

When cut from the loom and opened, the inner double-cloths exhibited the characteristic permanent crease that was discussed in Chapter 4, and illustrated in Figure 41. Personally I like the aspect of this crease because it adds structural history to the piece, once an experienced weaver sees it they would know how it was produced.

Textile #3.

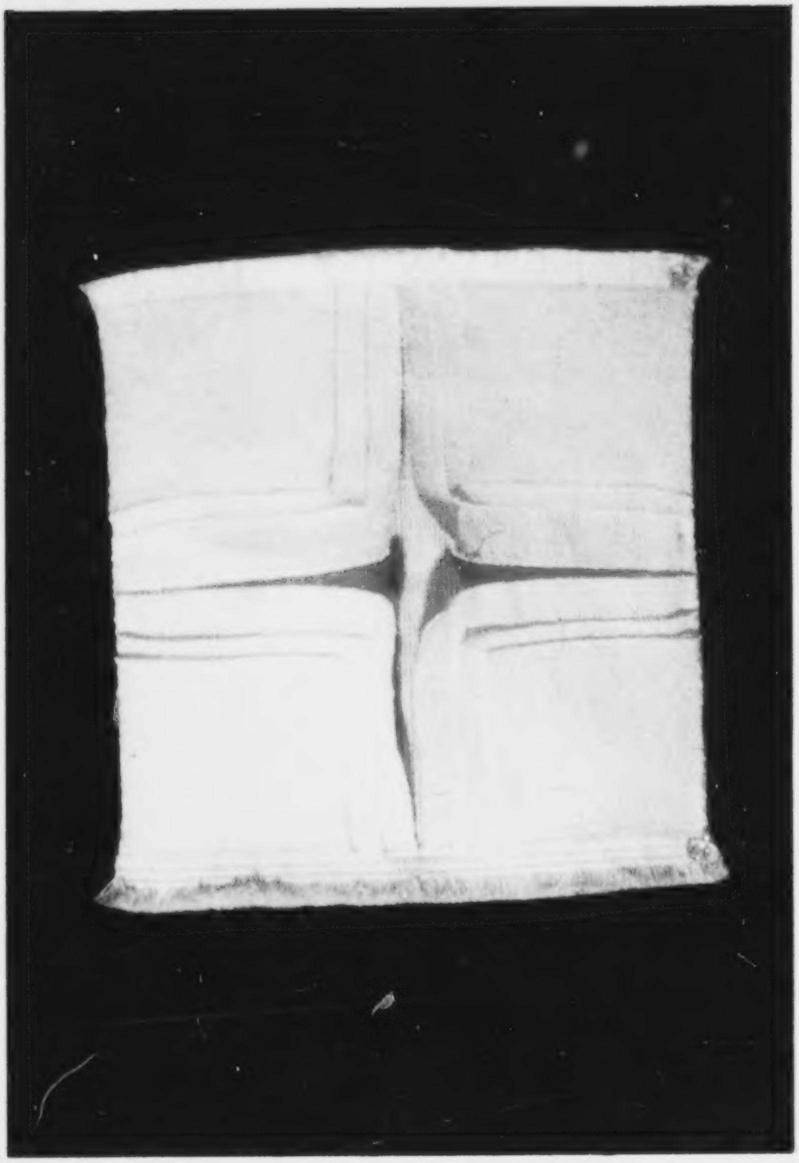


Figure 78. The design idea for small "Pagoda", shown flat, was derived from a paper folding game I played when I was a child called fortune teller, 9" x 9" x 9" (Photo by J.A. Renzi, 1995).

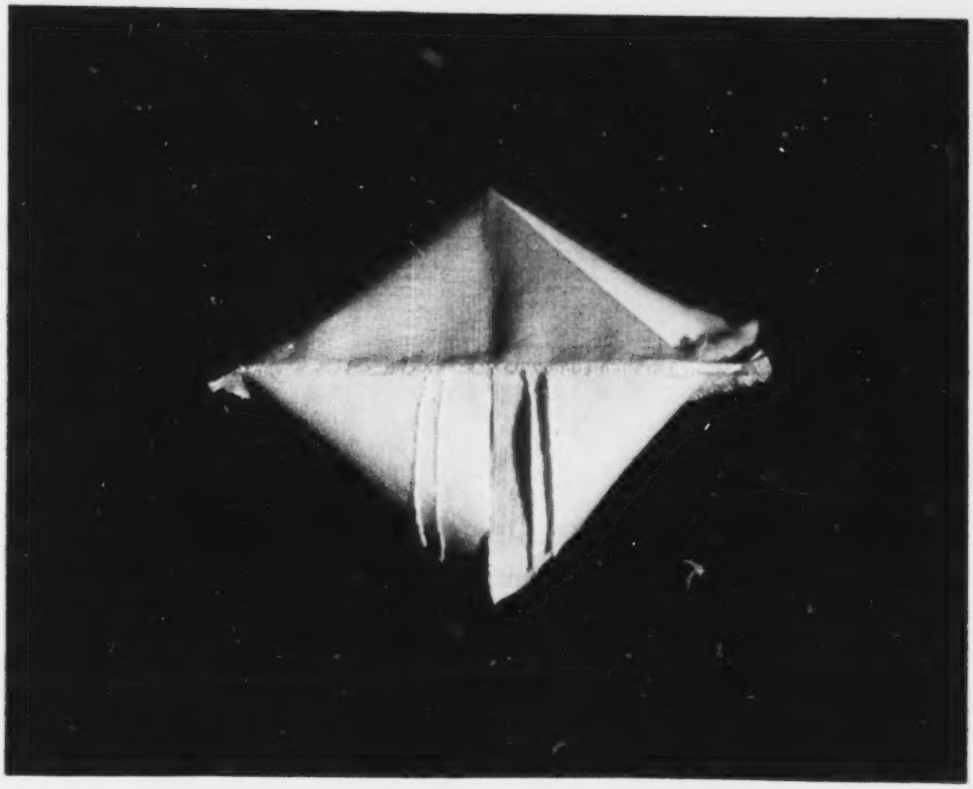


Figure 79. Small "Pagoda" opened up into one form possibility (Photo by J.A. Renzi, 1995).

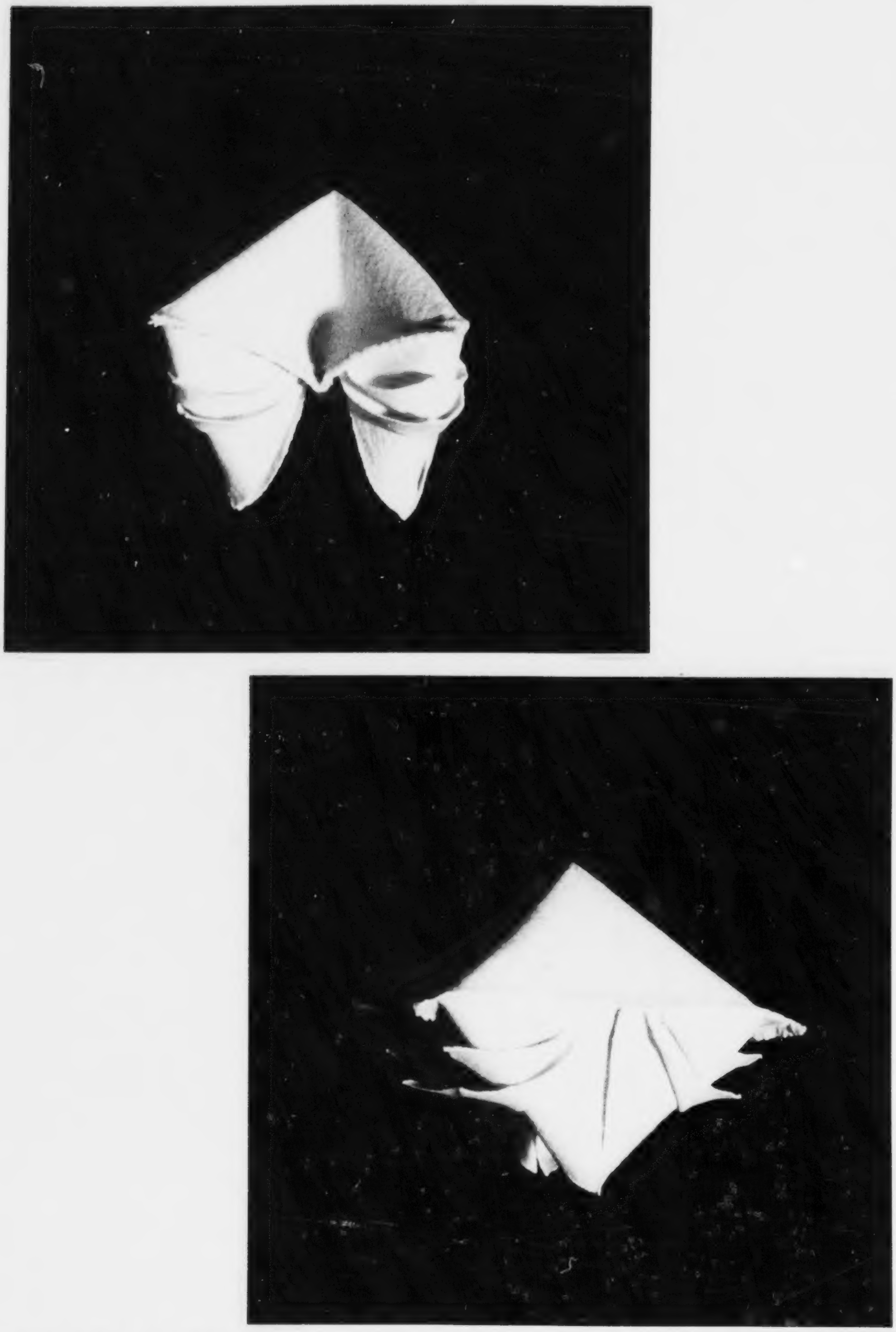


Figure 80. Small "Pagoda" manipulated into another form possibility (Photographs by J.A. Renzi, 1996).

Technical Description:

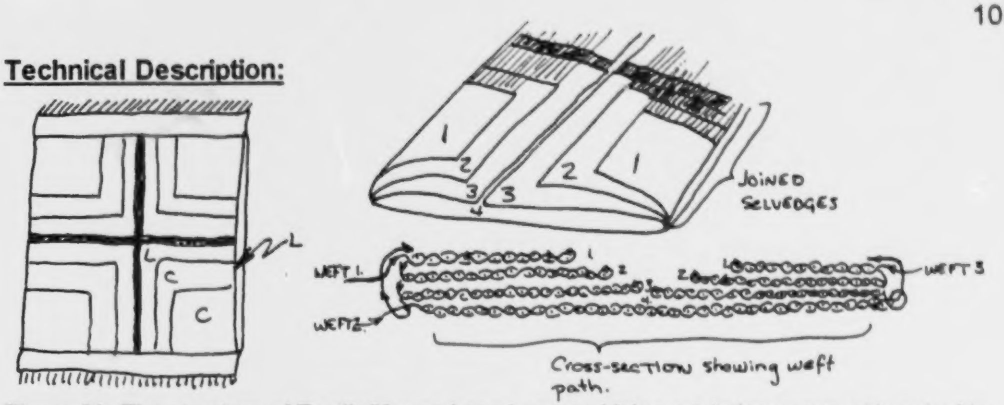


Figure 81. The structure of Textile#3 was based on combining a tubular weave with a double-width weave (Sketches by J.A. Renzi, 1996).

Personal Evaluation:

Textile #3 is the third three-dimensional form created from the cotton and linen warp. My design inspiration for the textile form was derived from a folded paper toy that I used to make with the other children in elementary school called a "fortune teller". This simple geometric form was primarily based upon transforming a flat paper square into a fully dimensional form through folding techniques. The possibility of opening up a flat, shape due to pockets that were created by folding, into a three-dimensional object, was the impetus for creating Textile #3 entitled "Pagoda".

The weave structure of this piece is also very simple and based upon a tubular weave structure combined with a double-width technique. The four warp layers were joined at the bottom and top edges along with the selvedges during production. The top and bottom, or non-selvedge, edges were joined by weaving all four layers into a "tabby" or plain weave. This structure can be seen in the computer weave draft of this textile (see Figure 82). I joined all four of the selvedges during production through my hand manipulation of the weft threads. I attempted to illustrate the path I took the weft threads in Figure 76.

Once this piece was opened up, the crisp hand of the linen material lent itself to the three-dimensional structure. This small textile form could be hung from only one point using monofilament thread, providing easy installation.

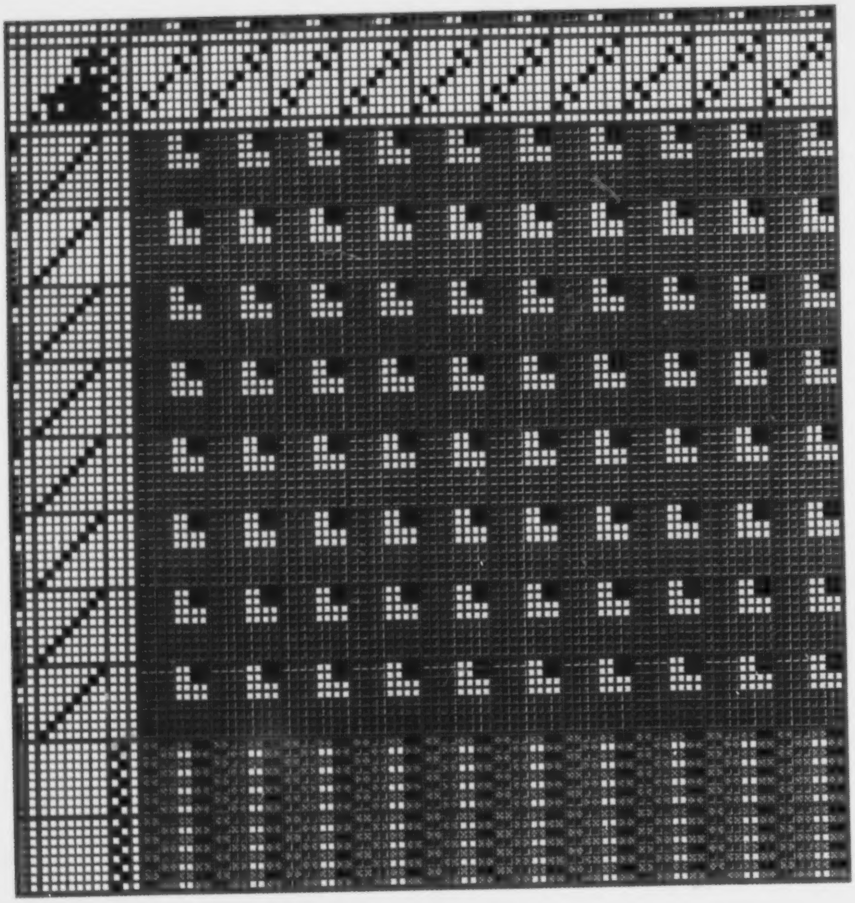


Figure 82. This quadruple-layered weave draft includes the tabby (or plain weave) tie-up that I used to create the non-selvedge edges of Textile #3 (Drafted by J.A. Renzi from Patternland Weave Publisher 2.1 [Computer software], 1991, Plainfield, Vermont: Maple Hill Software).

Textile #4.

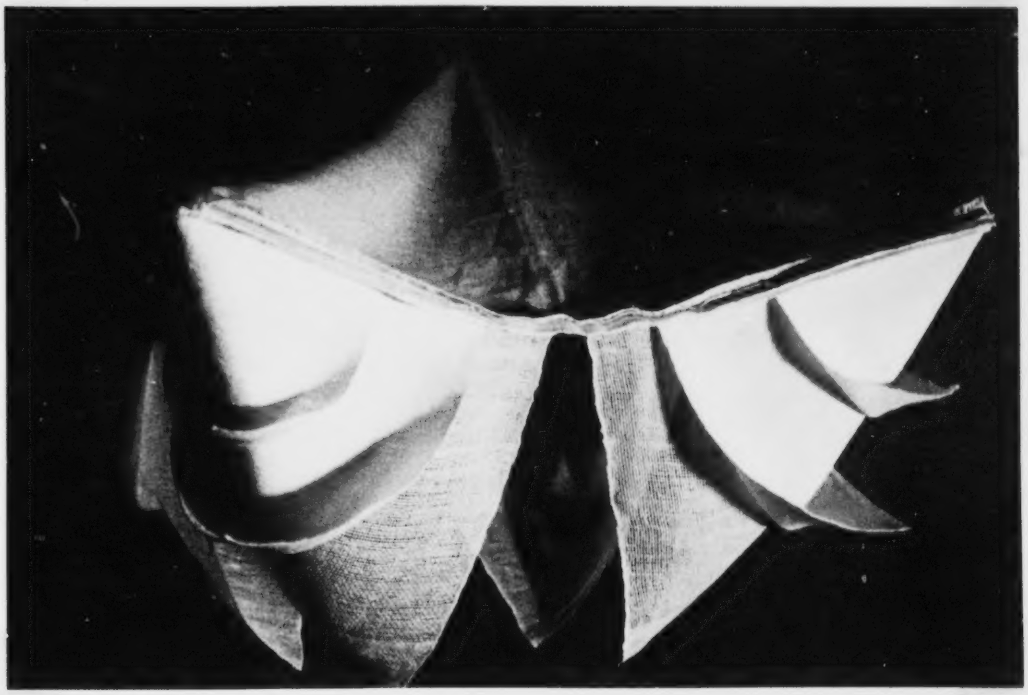


Figure 82. Large "Pagoda" quadruple-layer weave of 100% ramie, 27" x 27" x 27" (Photo by L. Boone, 1995).

Technical Description:

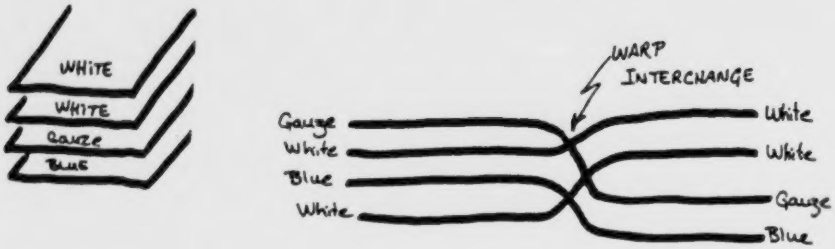


Figure 83. Similar technique as illustrated in Figure 78 with the addition of a warp interchange (Sketches by J.A. Renzi, 1996).

Personal Evaluation:

The larger scale, and the difference in fibre characteristics, of this ramie piece caused difficulty in replicating the crisp hand and inherent structural stability of the linen used in Textile #3 (see Figure 78). Textile #3 served as the prototype for this textile; however, my personal judgement changed certain structural design characteristics for Textile #4.

The two non-selvedge edges, woven with all four layers incorporated into a plain weave in Textile #3, were converted to a warp interchange technique. The incorporated edges of Textile #3 proved much more structurally stable than those created from the warp interchange in Textile #4. This instability was not noted until after the textile form needed to be installed.

Not only was the technical procedure of Textile #4 difficult to produce but the warp tension was difficult to control. Cardboard strips were placed in the sheds of the non-woven horizontal areas between the woven squares of each layer. The non-woven vertical areas between each square was not as easily treated and therefore left unwoven throughout production. The warp tension in these non-woven areas gradually became looser, and by the end of production the threads were unworkable. This warp tensioning problem, which mildly effected Textile #3, increased during the production of Textile #4.

Even if Textile #4 was of a crisper material, its increased scale causing additional weight would probably still alter the intended appearance. The modification of the third layer into a gauze textile proved an interesting design characteristic because it does not obstruct the viewers observation of an additional dimension. This gauze characteristic was utilized further in the development of Textile #5.

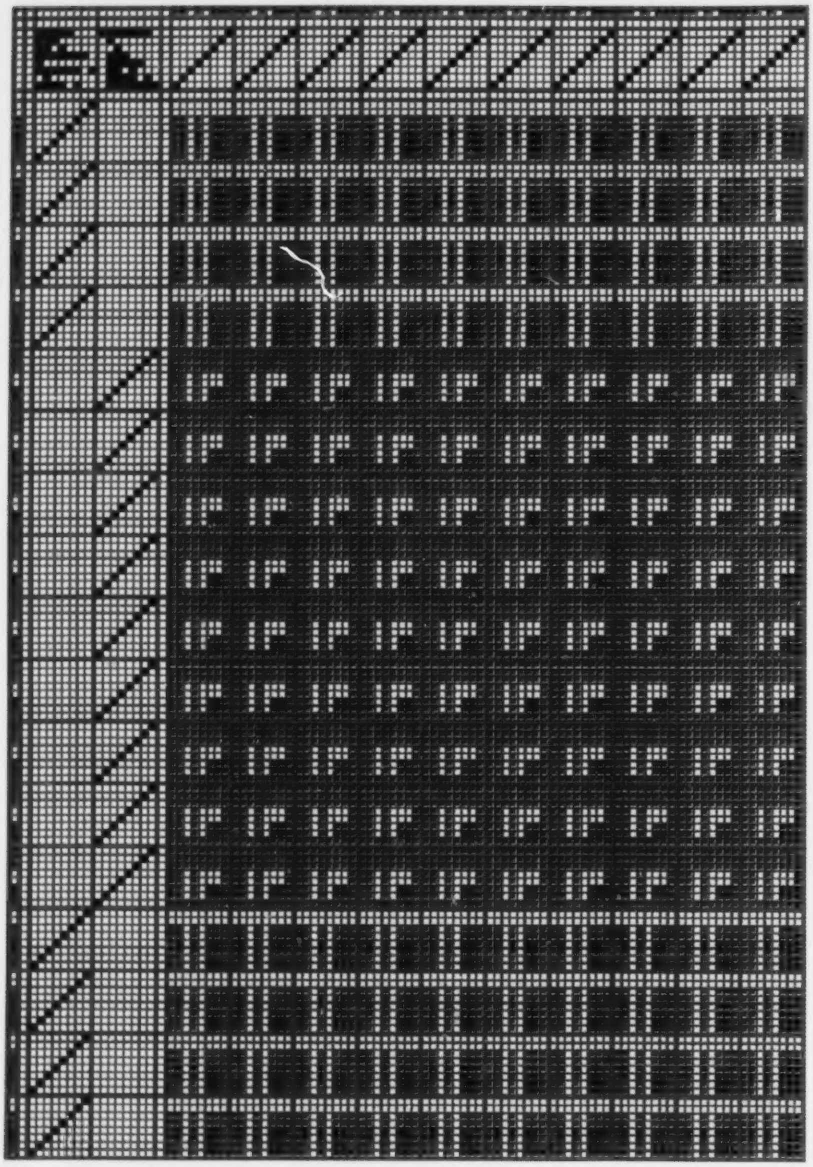


Figure 85. Basic draft for the quadruple-layered warp interchange that I designed for Textile #4 (Drafted by J.A. Renzi from Patternland Weave Publisher 2.1 [Computer software], 1991,Plainfield, Vermont: Maple Hill Software).

Textile #5.

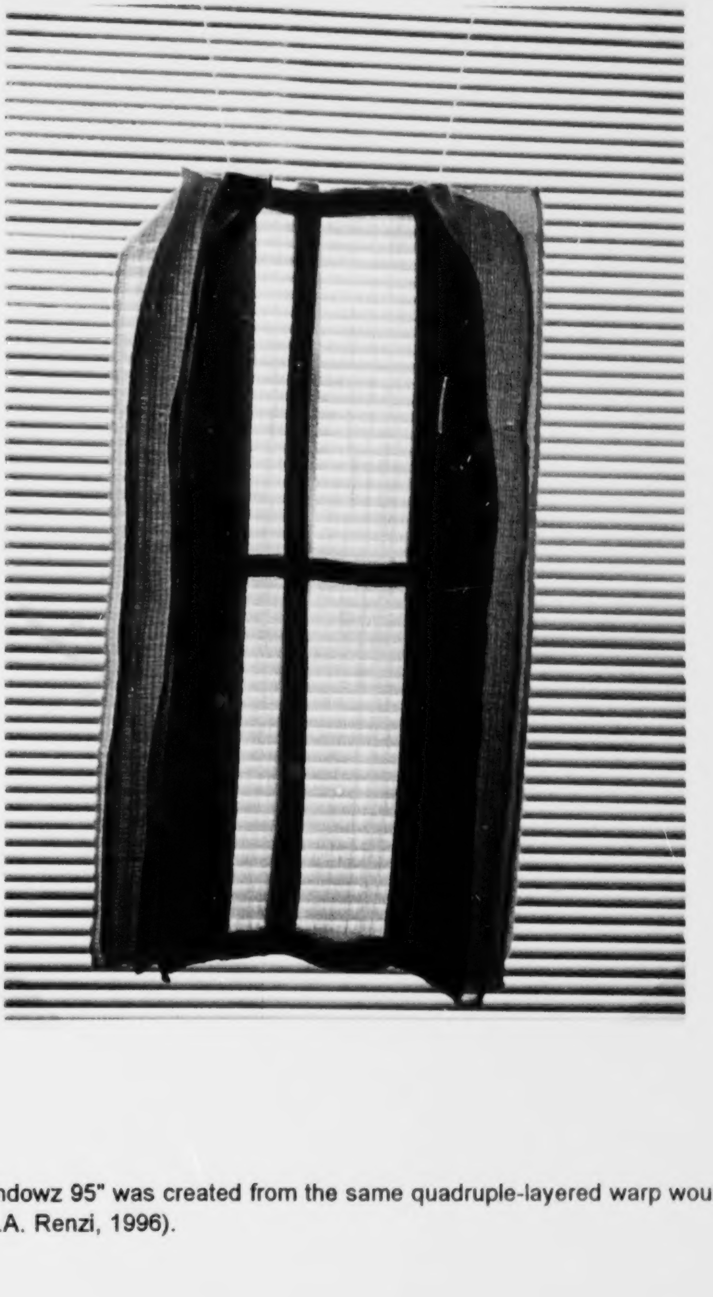


Figure 85. "Windowz 95" was created from the same quadruple-layered warp wound for Textile #4 (Photo by J.A. Renzi, 1996).

Technical Description:

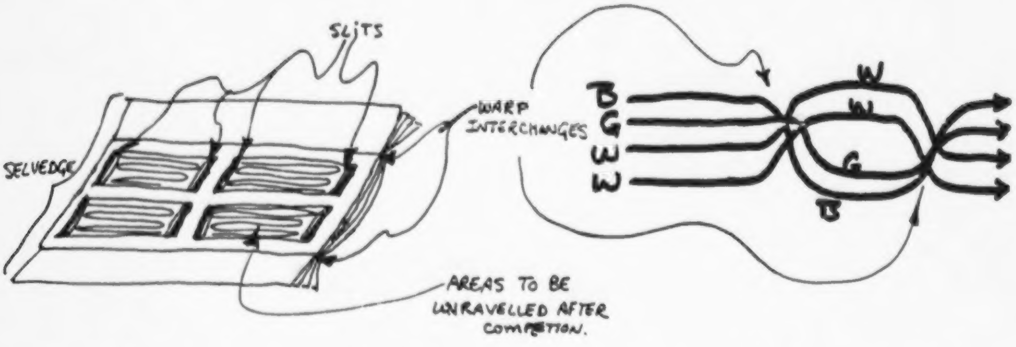


Figure 86. This piece was created on the loom sideways using warp interchanges and weft manipulations (Sketches by J.A. Renzi, 1996).

Personal Evaluation:

The remainder of the ramie warp used for the production of Textile #4 was utilized for Textile #5. Due to the tensioning problem that occurred during the production of Textile #4, the warp had to be retied onto the front take-up beam. To remedy the reoccurrence of this tensioning problem, I decided to weave the non-structural areas, mainly horizontal, with thicker yarns that could be removed after the piece was completed. This solution proved more successful than placing cardboard in the sheds. By removing the cardboard, which hindered the action of the beater, I could beat the weft threads into place while weaving the gauze layer underneath the "non-woven" layers.

The idea of hand manipulating the weft threads was based upon the techniques used by tapestry weavers. These techniques are time-consuming yet give the desired results. I made many of my design decisions for Textile #5 during the handweaving process. I also realized, by weaving this textile at a ninety degree angle to how it would be presented, that design problems could be solved upside down and backwards as well as the "right way 'round".

Thesis exhibition strategy

My thesis exhibition strategy evolved from the various installations of my work that I designed for different exhibit spaces. My first installation was set up in the loom/production room on the second floor of the HEC building for my graduate seminar (see Figure 88). This was my first attempt at presenting my work within an architectural environment not originally designed for exhibition. The room was large and housed excess unused office furnishings which provided many visual distractions.

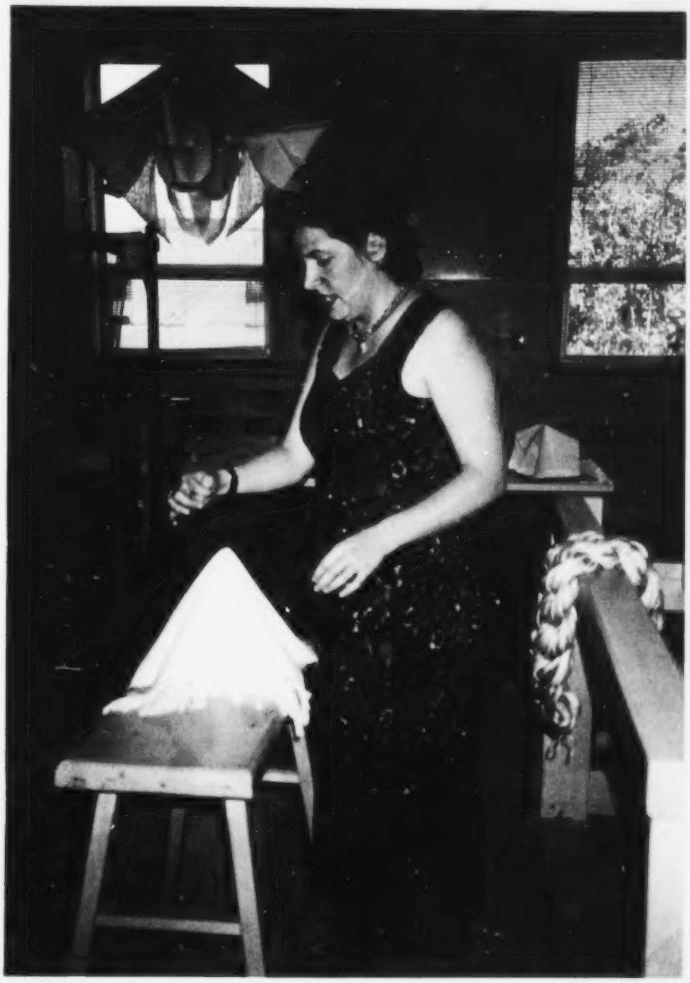


Figure 88. Seminar exhibit room proved quite crowded as seen in this photo taken by A. Lambert (1995).

My search for solutions to possible exhibition problems progressed to the the second installation of my work. I installed my three-dimensional textile forms in an alternative space in Grandin Mall, St. Albert (see Figure 89) as part of a week-end invitational exhibition organized by The St. Albert Artist's Association. My textile forms were shown in a collaborative space with textile artist Wendi Weir's indigo shibori pieces. The simplicity and open-ended design concept of my forms combined with Weir's simplicity of colour and design to create a harmonious atmosphere. The post-commercial space with its glass front and intimate space allowed me to present my three-dimensional forms in yet another manner. This show of textile art works was deemed successful by the organizers and was extended for an additional two weeks.

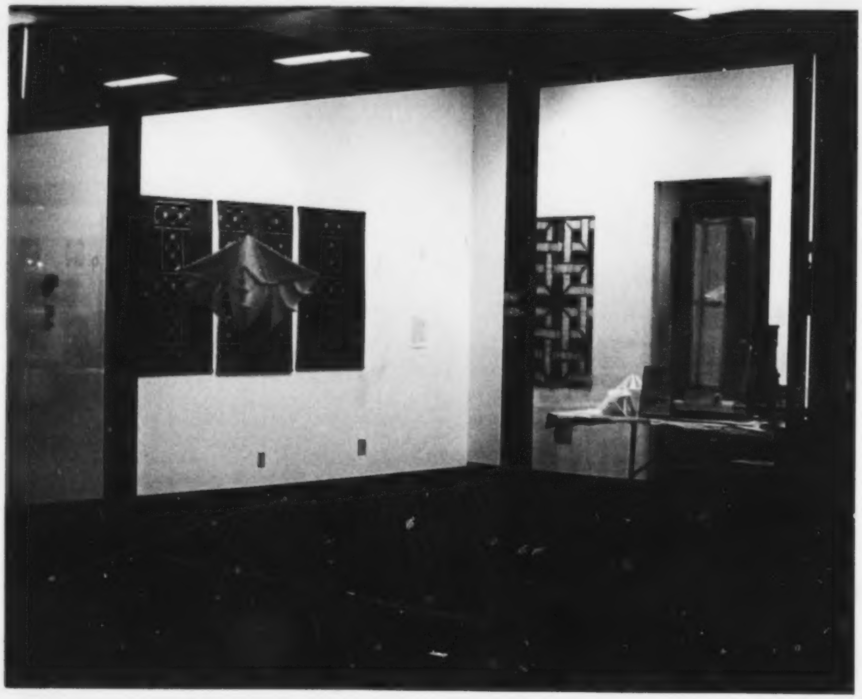


Figure 89. Exhibition in Grandin Mall, St. Albert showing my work with Weir's indigo shibori work (Photo by J.A. Renzi, 1995).

For the purposes of my thesis defense, I wanted to show my works in close proximity to where I would present to my committee. Originally, the desired scale of the pieces was large enough to accommodate a whole person, creating a portable environment. Due to the reduction in scale, changes had to be made in my own aesthetic perceptions of how the pieces were to be shown. The small size of the pieces demanded no distractions, so a smaller room in which to view the pieces was chosen.

I decided to use room 109A, located on the first floor of the HEC building, as a temporary exhibition space. The room was approximately 12' x 20' with a ceiling height of approx. 12'. It had only one window, fixed shut, covered by a horizontal mini-blind. This blind was kept closed to eliminate visual distractions, and to decrease the amount of UV light affecting the pieces.

The ceiling was segmented, making it easy to install hanging forms. I decided not to use the built-in, overhead fluorescent lighting as it was too harsh and emitted UV light. Instead, I opted for free-standing pot lights, using 60watt Soft White© bulbs. The linoleum tile floor and wall outlets were covered with oversized sheets of white paper, crumpled to give texture. The desired effect; an intimate environment with pieces placed on plinths of varying heights, or hung slightly above average eyelevel (see Figure 90).

The need for monofilament thread at more than one point in order to hold the form proved complicated and time consuming. It is possible, however, to hang the large "Pagoda" piece from only one point using monofilament thread and Plexiglas rods. My personal design preference was to create these forms without the aid of stiffener or stuffing incorporated into the structure of the piece. However, the use of removable armatures as separate entities, while maintaining conservationally acceptable characteristics (eg. Plexiglas© tension rods), would be necessary to solve installation and inherent structural problems.

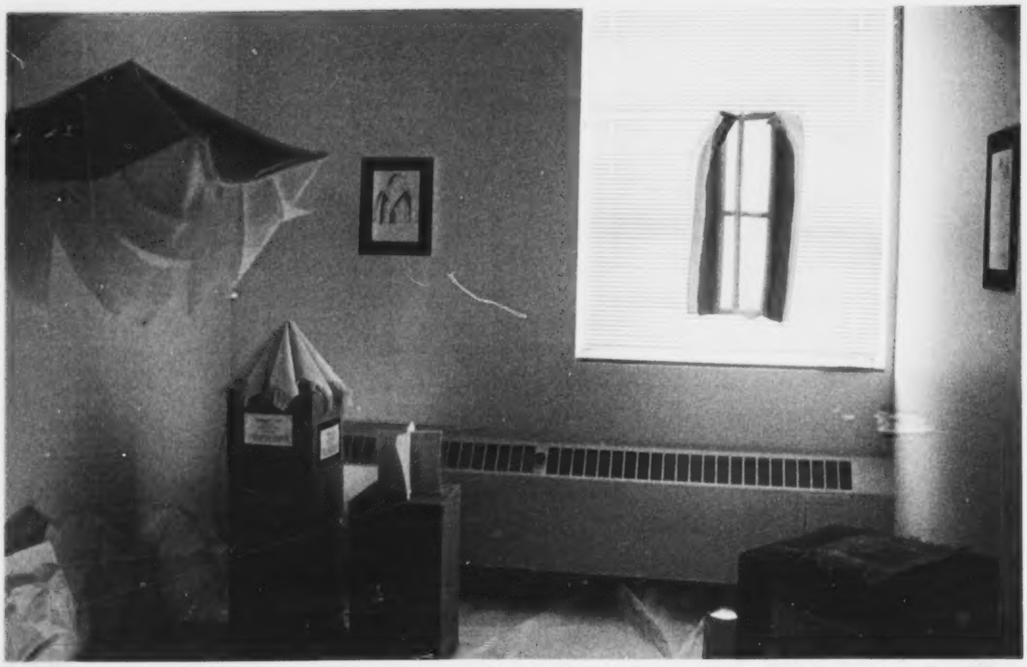


Figure 90. Installation of my works in the HEC building during mid-day (Photo by J.A. Renzi, 1996).

6. SUMMARIZATION

The purpose of this study was to explore the possible three-dimensional textile forms that could be obtained solely through traditional and inventive on-loom handweaving techniques. Due to the plethora of research methods comprising weave design research, I adopted a holistic approach for this investigation. As an artist I also drew upon my personal experiential knowledge and reified it using personal interpretive methods including visual analysis. The examination and documentation of these methods was also part of this inquiry. I stressed the importance for textile artists to interpret their introspective thoughts and creative processes and record them for future reference.

During the preliminary stages of the research project I conducted an exploration of my visual and literary influences. The inclusion of visual data in the body of this thesis was crucial in accurately explaining my design influences. The primary focus of these influences was the existence of structure and form within space and their effect on individuals. Architectural, sculptural and natural forms were examined and discussed. My own personal experiences within architectural spaces were interpreted and documented as sources of inspiration.

Following the exploration of traditional double weaving techniques which included the analysis of historic Peruvian and jacquard textiles, I reviewed the few existing documented processes developed by current contemporary weave artists. After contemplating the resources available to me, my physical limitations, and general health and safety concerns, I chose the natural cellulosic fibres of cotton, linen, and ramie as my media for this investigation. The combination of traditional complex weave structures with my own technical developments in multi-layered weave structure culminated in the production of five three-dimensional, multi-layered, textile forms.

As a result of the holistic research I conducted and the exploration of my visual and literary resources, I developed my own personal process for creating three-dimensional, multi-layered, textile forms. I divided this process into two main phases, the visualization process and the intuitive process. During my visualization process, I realized my designs through two-dimensional spatial interpretation and depth perception using preliminary sketches. The intuitive phase of my design process saw the construction of my three-dimensional textile forms completely on the loom. Through mathematical solutions and previously undocumented weft thread manipulations, I achieved seamless, three-dimensional textile forms. I documented my personal process using sketches, my own journal entries, computer-aided design drafts, and warp preparation calculations.

After completion, the textiles were cut off the loom and prepared for post-loom manipulation. In order to achieve the desired visual effects, the flat woven pieces were opened up to simultaneously encompass and occupy space. The subsequent arrangement of these three-dimensional forms was an important consideration for exhibition purposes. My decisions as to how and where the forms were exhibited depended upon the dimensions of the forms themselves in relation to the space they were to occupy. During this proto-structuralization of my pieces, each of the textile forms I created were installed and presented in one of the many possible variations of forms. My personal aesthetic preference as to how these pieces were exhibited was documented along with a few alternate form variations to demonstrate the open-ended design concept that I implemented.

This investigation resulted in the identification of future research possibilities in woven three-dimensional textile forms, fibre art conservation and computer-aided, three-dimensional textile design. These possibilities are outlined in the following section. There is an emerging interest in the production of three-dimensional textile forms within the textile industry. This study of the processes involved in handwoven three-dimensional textile production could influence the developments made in future industrial applications.

I offer my thesis research as an example of how one designer of complex weave structures has surpassed traditional and cultural boundaries through the application of alternative problem solving. By implementing holistic methodologies, complex weave designers and producers, both hand and industrial, may invent textile structures and techniques that exceed their own expectations.

Future Research Possibilities

The search for new and interesting ways of creating, while maintaining a conservational awareness, is an unending process. The creative research possibilities of handwoven, three-dimensional, multi-layered textile forms demand continuous exploration and experimentation. I have only touched the surface of the potential designs that can be produced. In the future I intend to incorporate multifarious natural and chemical dye techniques with the structural development of three-dimensional textile forms. By combining colour theory with weave structure, interesting aesthetic ideas may evolve.

The textile designs completed during the weaving component of my exploration and which form the body of this thesis lead to further avenues of investigation that I will continue to pursue in the future. The topics of investigation that fascinate me are:

1) the continuous experimentation and development of multi-layered weave structures combined with colour and chemical effects,

2) the presentation of three-dimensional textile forms within exhibition spaces, and

3) further research into computer-aided design possibilities for development and production of three-dimensional, multi-layered textile forms.

1) Colour and chemical effects

New textile sculptural effects can be generated from combining complex weave structures and various industrial surface design processes. Japanese textile designer Junichi Arai has been very successful in this regard. The double-weave silk and cotton textile that I created (see Figures 91-94) was treated with a chemical solution that shrunk the cotton (cellulosic) producing puckers in the unaffected silk (protein) cloth. This chemical process is known as cloqué. Another promising chemical reaction that I wish to investigate is a burn-out technique called devoré. When a textile is treated with this solution, cellulosic fibres are disintegrated leaving the unaffected fibres to maintain the fabric structure.

Experiment #1.

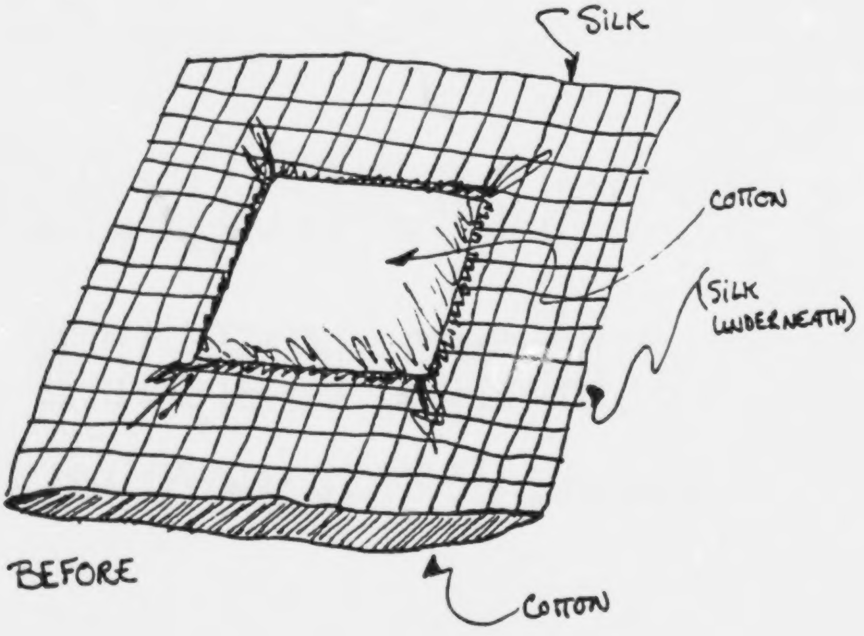


Figure 91. Experimental chemical reaction on a cotton/silk double-weave structure showing the textile before the reaction (Photo by J.A. Renzi, 1996).

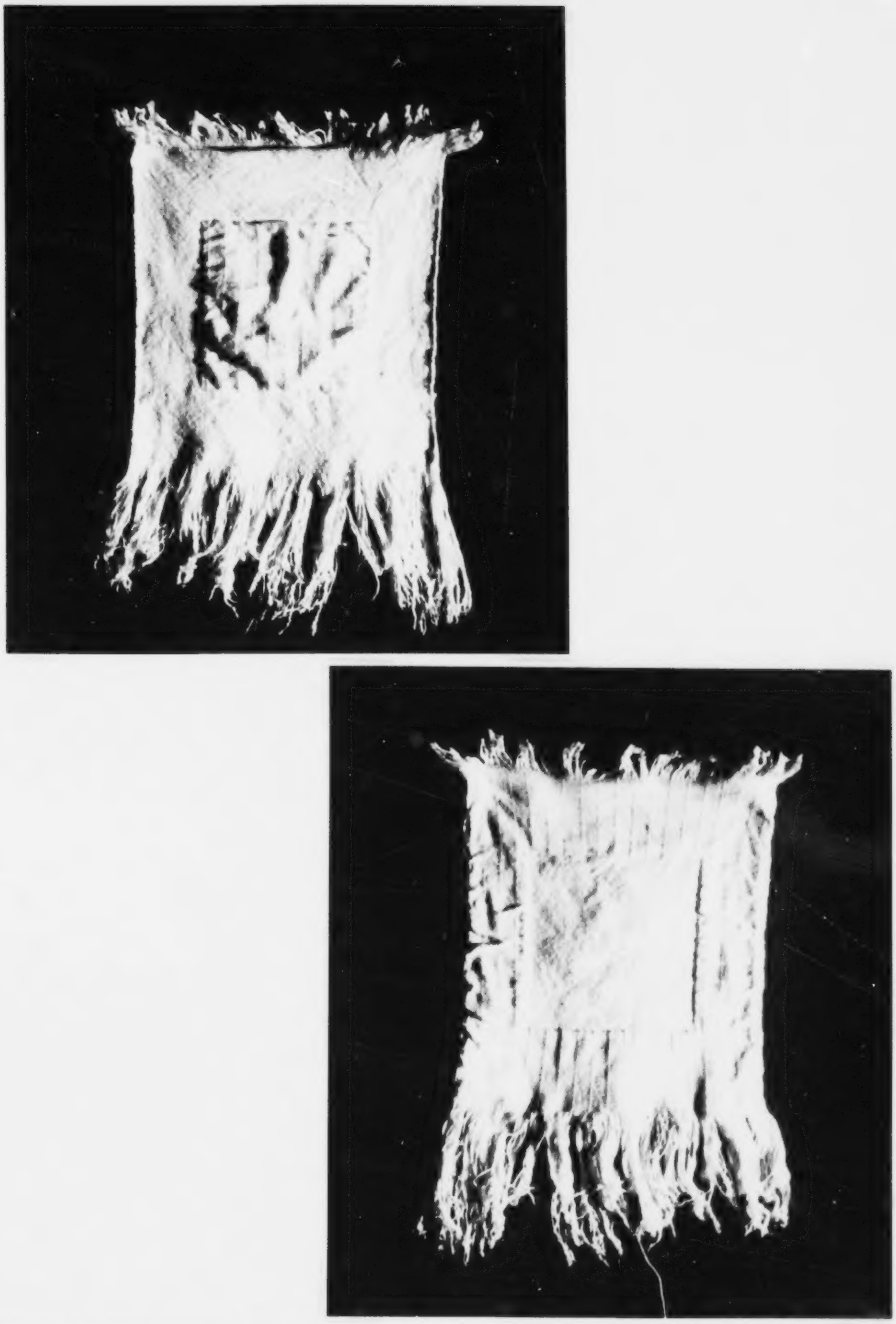


Figure 92. Cloque experiment after the textile was place in the sodium hydroxide solution (Photo by J.A. Renzi, 1996).

Technical Description:

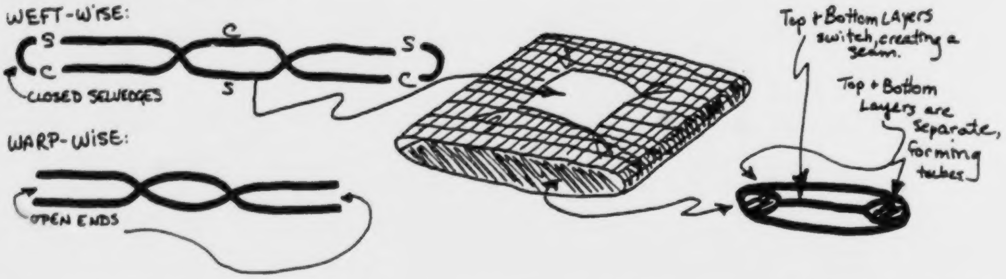

WEFT-WISE:
S
C
C
S
S
C
CLOSED SELVEDGES
WARP-WISE:
OPEN ENDS
Top + Bottom LAyers switch, creating a seam.
Top + Bottom Layers are Separate, forming tubes

Figure 93. This double weave technique combined weft and warp manipulations with a tubular weave structure (Sketches by J.A. Renzi, 1996).

Personal Evaluation:

Experiment #1 was created as a double-cloth using a combination of threads in order to create an innovative structural design (see computer draft, Figure 94). The materials used in the production of this piece were a warp of protein fibre: silk, and a warp of cellulosic fibre: cotton. These fibres were chosen for their inherent chemical characteristics and physical qualities.

During the winding of the warp, I placed a two-ply silk yarn after every tenth silk thread. In order to produce a woven textured pattern in the cloth, I placed a two-ply silk yarn after every fourteenth weft shot during the production of the silk layer. The cotton layer was woven simultaneously underneath the silk layer. I created the square pocket in the centre of the piece by combining a warp switch with a corresponding weft switch.

Once removed from the loom, the piece was placed in a solution of 30% by weight Sodium Hydroxide (NaOH) for five minutes. The textile was then placed in a cold water rinse for ten minutes. Following this rinse, the piece was placed in a neutralizing solution of acetic acid (5 tsp.acetic acid per 8 cups water) for thirty-five minutes and then rinsed again in cold water for five minutes. The textile was then allowed to air-dry and the resulting reaction shrank the cotton fibres causing the unaffected silk cloth to pucker.

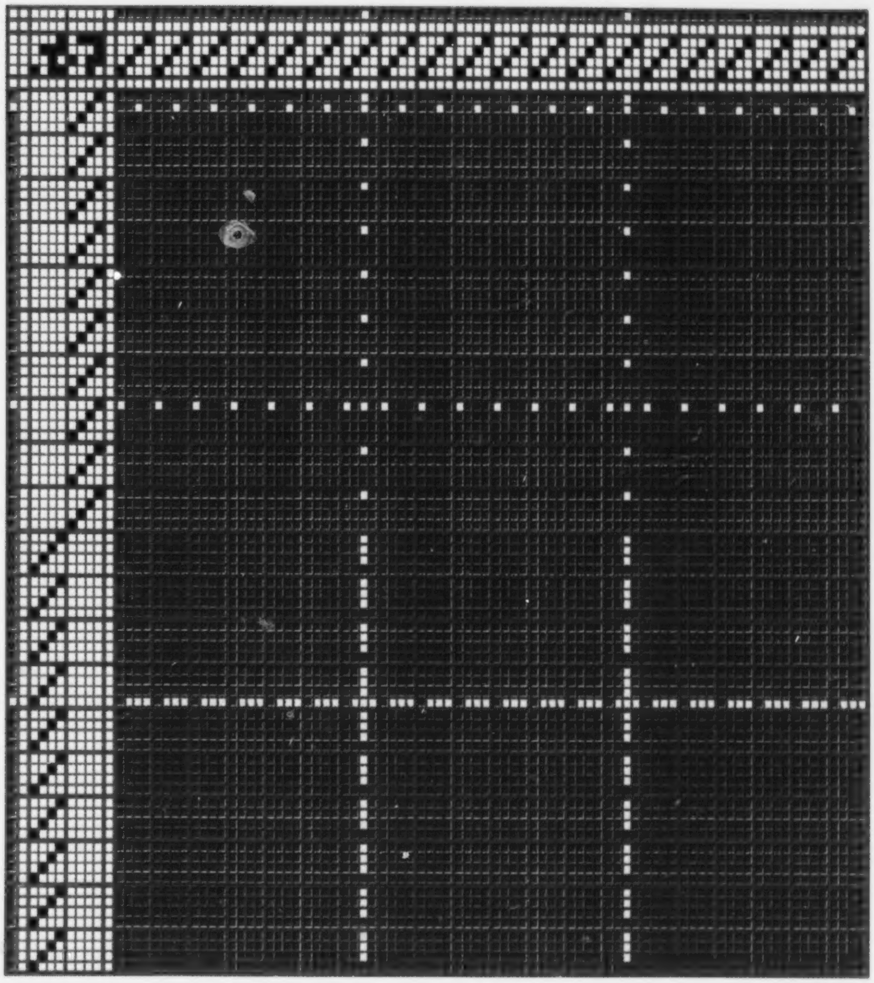


Figure 94. Double layer draft for experimental textile depicting the warp interchange (Drafted by J.A. Renzi from Patternland Weave Publisher 2.1 [Computer software], 1991, Plainfield, Vermont: Maple Hill Software).

By implementing various hand and industrial dying techniques into three-dimensional, multi-layered textile structures, I could achieve other structural possibilities. The utilization of colour and weave theory offers me as a weave designer an infinite amount of possible structural combined with surface effects. Possible developments in dye chemistry offers fusions of chemical and colour effects which may allow textile artists like myself to dye, resist, and burnout at the same time.

2) Exhibition spaces

Creating portable environments as installation art in order to achieve human/fiber art interaction is my main objective for the future. By taking large three-dimensional textile forms juxtaposed within architecture, innovative spatial constructs and environments are possible. By increasing the scale of my pieces, an entire room could be transformed from a square box to an intimate escape. Not only can these three-dimensional forms interact with interior spaces, but also with exterior spaces. Environmental three-dimensional textile installations could be employed in natural surroundings to create temporary shelters or art installations that enhance specific natural phenomena.

3) Computer aided design

Another addition to the infinite possibilities of complex woven textiles is CAD program development for three-dimensional textile forms. Current computer aided weave programs on the market do not have the capacity to freely explore three-dimensional form or adapt to different types of looms (eg. countermarche looms have a completely different way of drafting the tie-up from jack-type looms). Weave design programs are static and flat grid based, allowing only for drafting limited structural designs, visually interpreting designs two-dimensionally, and prohibiting weft manipulations. By assimilating computer animation program technology, offering texture grids and full three-dimensional visual capability, with a complex weave draft program, three-dimensional weave design can be taken to the next level.

Relatively new industrial applications of three-dimensional shaping techniques combined with inventive computer aided design programs, may lead to imaginative directions for textile artists. The possible directions that industrial three-dimensional textiles can take depend entirely on whether industry is open to becoming holistic in nature, incorporating handweaving techniques into their automated domain. This kind of experimentation using handwoven techniques will guide the evolution of new concepts and solutions to old design problems.

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Primary Sources

Renzl, J. A. personal collection of artworks, sketches, and photographic images.

Artifacts from the Clothing & Textiles Collection, Department of Human Ecology, University of Alberta:

Accession Number	Object Name, Origin	Material Technique
970.6.1	textile fragment, Canada	woven, double-cloth
970.7.13	textile fragment, Canada	woven, double-cloth
970.7.14	textile fragment, Canada	woven, double-cloth
970.16.1	F.L. Wright textile, 1965, USA	woven, plain
	Decorative Technique:	printed, screen
970.16.2	F.L. Wright textile, 1965, USA	woven, plain
	Decorative Technique:	printed, screen
983.14.25	ribbon, Peru	handwoven, supplementary warp; woven, added warps
984.17.5	textile fragment, Late Horizon, Inca, Peru	handwoven, plain; woven; double-cloth
984.17.7	textile fragment, Middle Horizon, Huari, Peru	handwoven,double-cloth, tubular
986.37.1	textile fragment, Peru	handwoven, plain; double-cloth
985.61.1	backstrap loom, Bolivia	woven, added warps
986.32.1	W. Morris curtain, UK, England	woven, jacquard, double-cloth

986.32.2	W. Morris curtain, UK, England	woven, jacquard, double-cloth
986.37.1	textile fragment, Peru	woven, double-cloth
993.22.143	bag, Cora culture, Mexico	woven, double-cloth, Mexican

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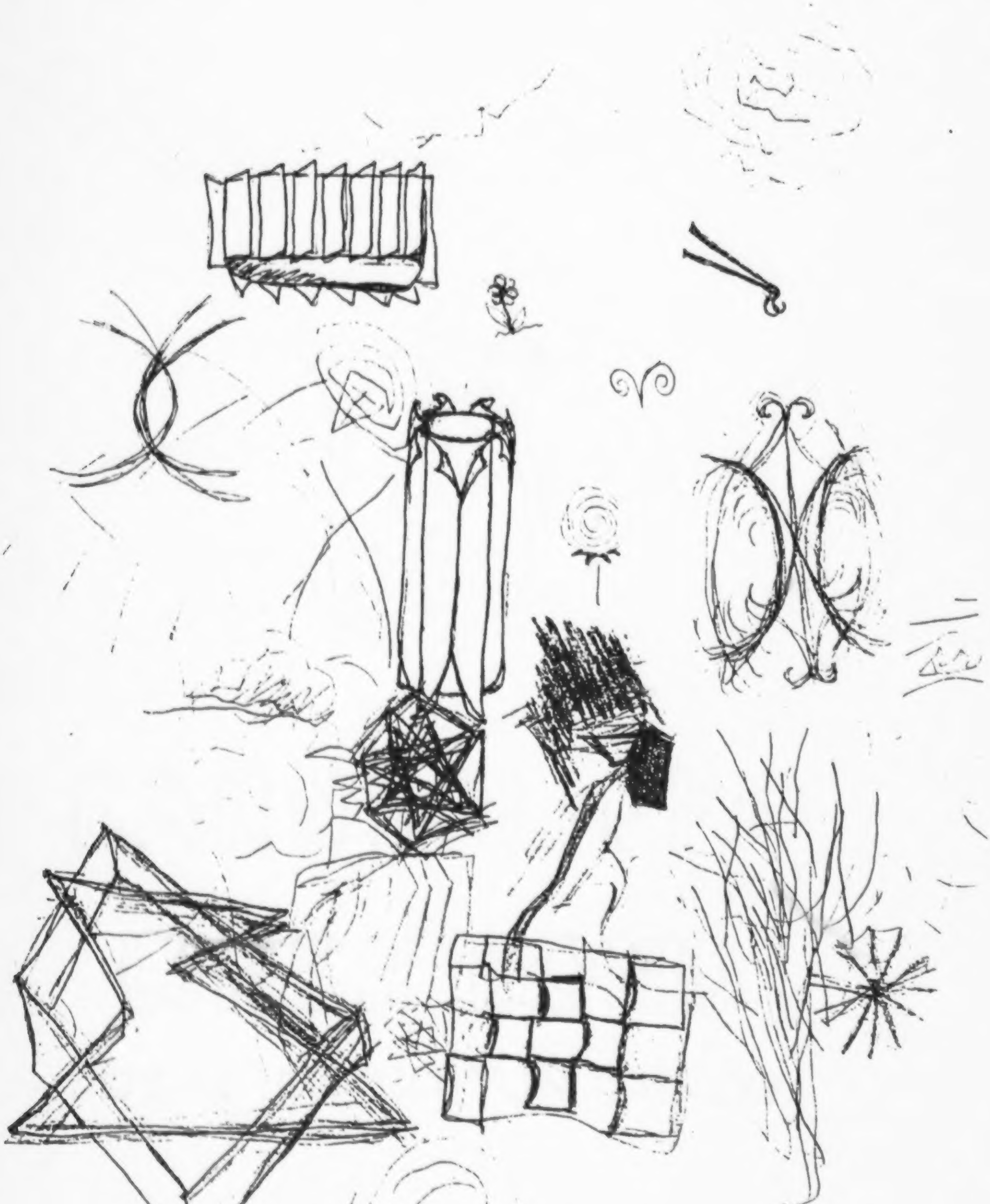
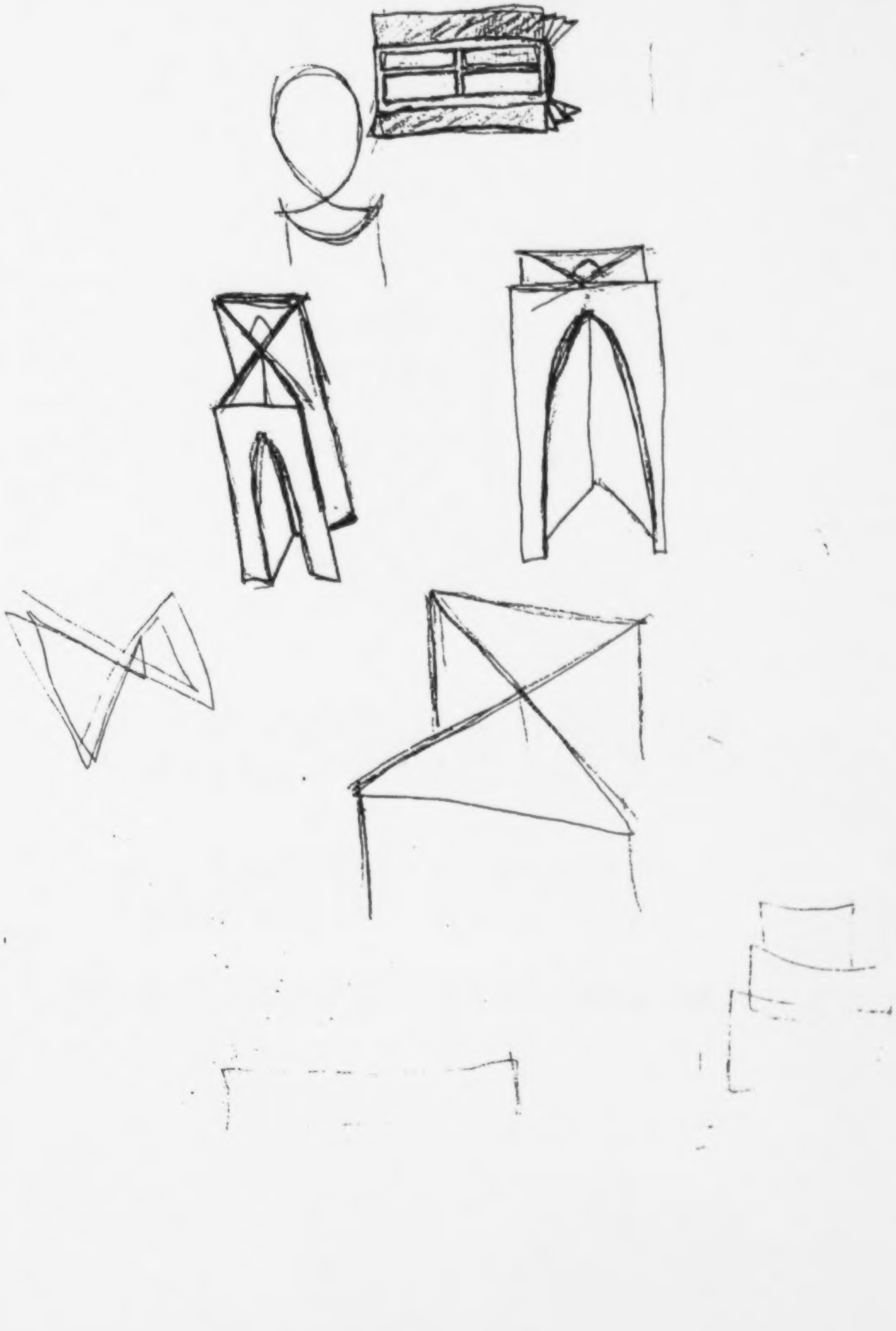
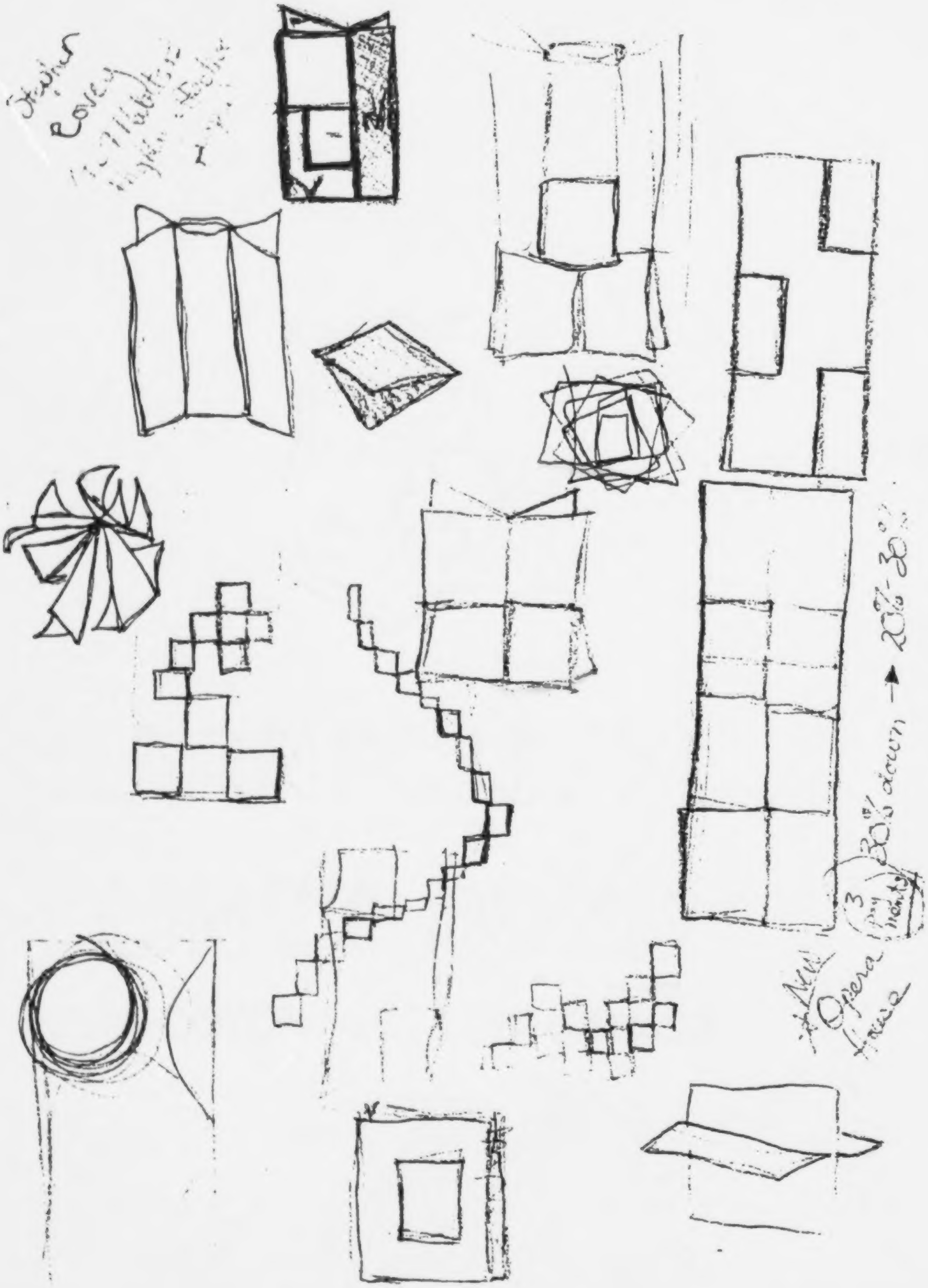
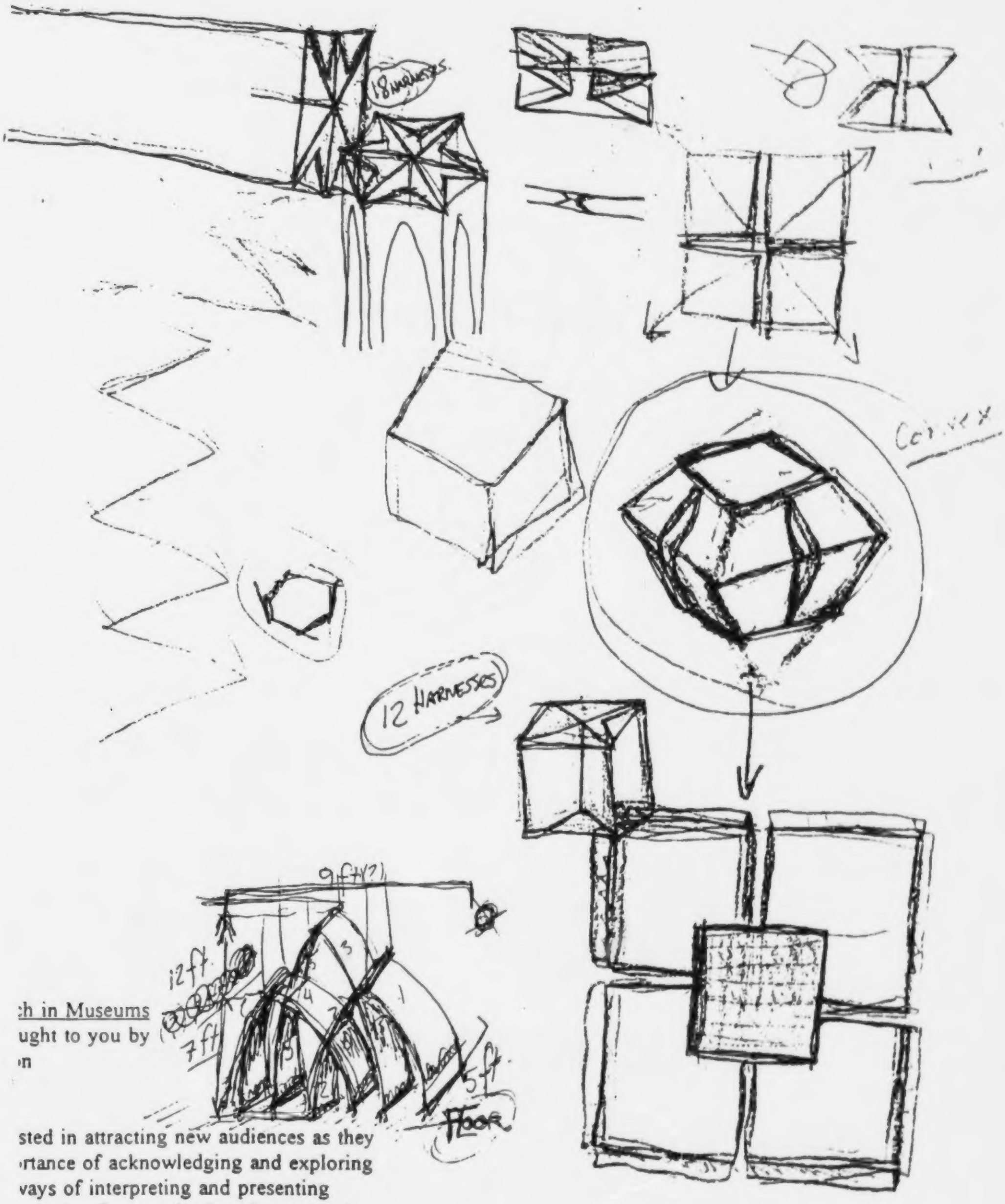
Appendix A:

I produced the following sketches during my visualization process. These two-dimensional renditions of three-dimensional forms were collected from sketches I made on an assortment of scrap paper and reproduced by photocopier. I used whatever paper was at hand whenever I was inspired by a design idea. Therefore the original sketches were produced on a variety of lined and unlined loose-leaf paper, scraps of note paper, and torn bits of recycled paper.



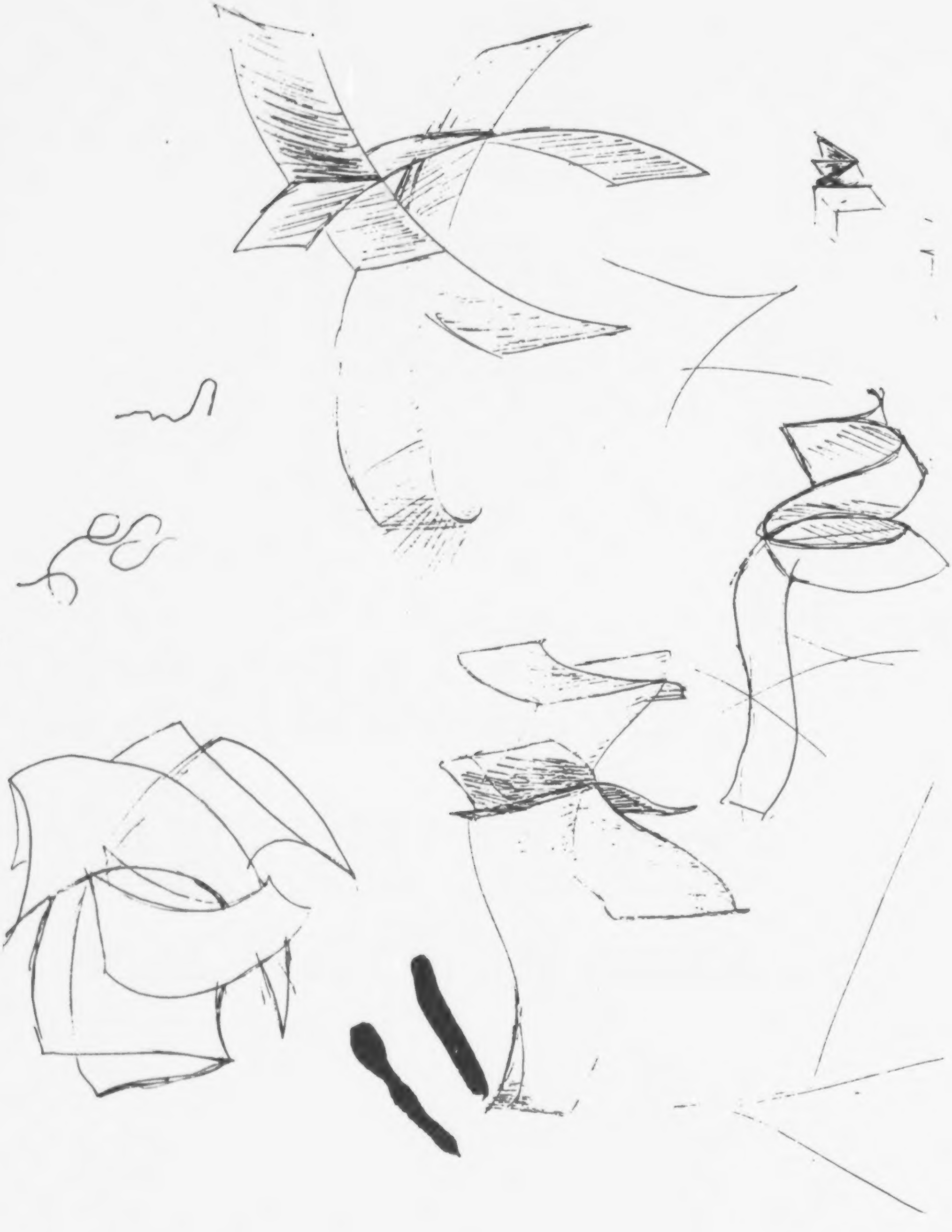


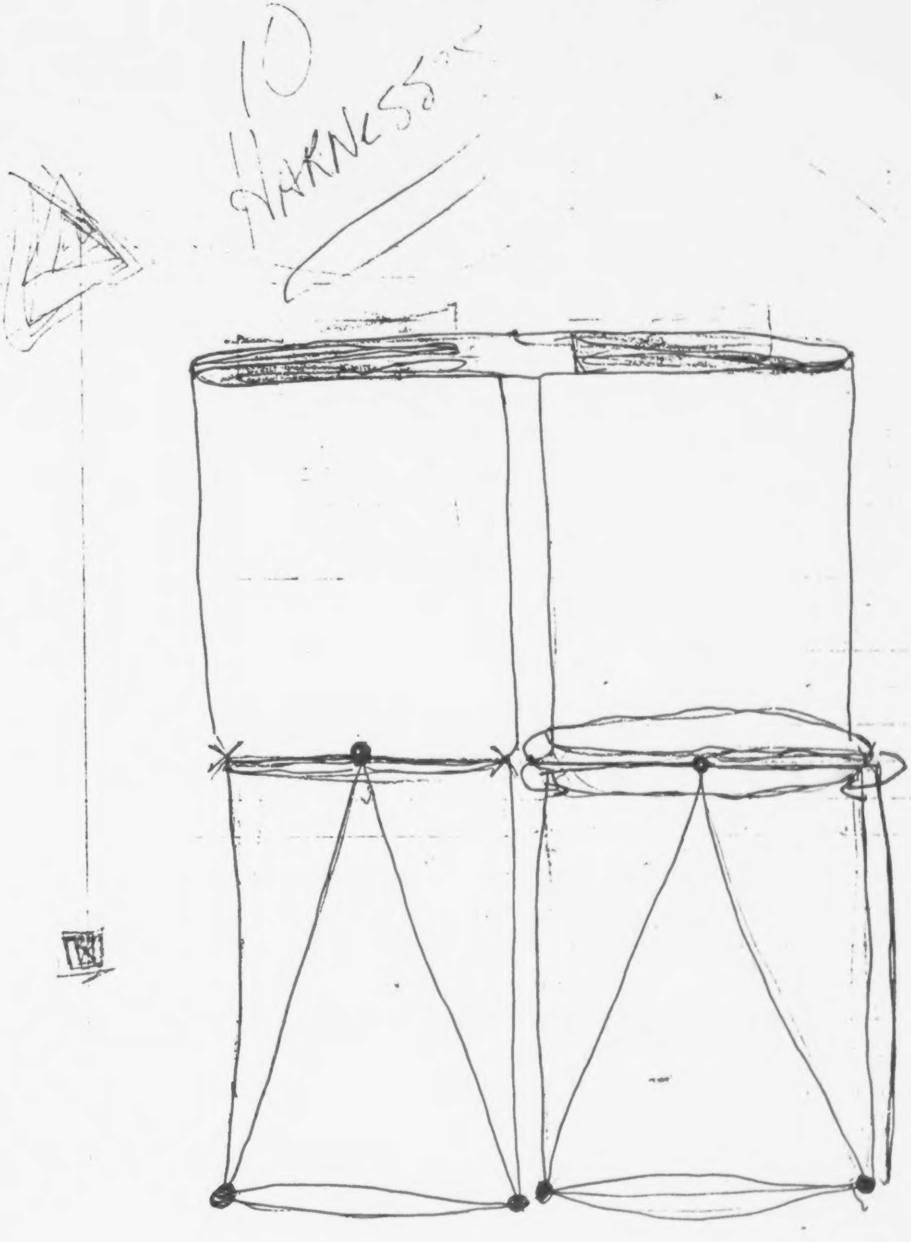

Stephen
Covey
7 Habits
[illegible] Leader
I
New
Opera
House
3
Day
[illegible]
30% down → 20%-30%

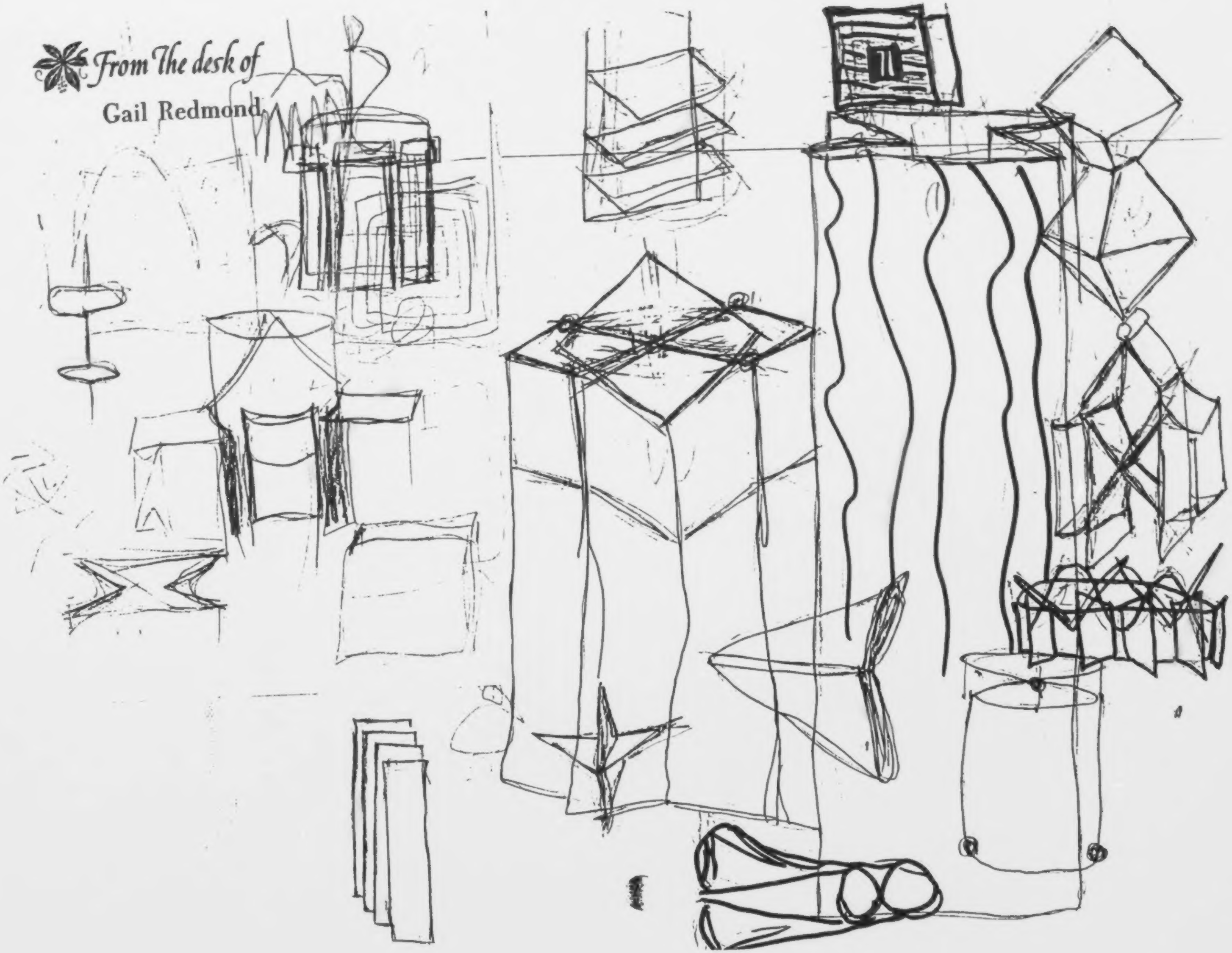

18 HARNESSES
Convex
12 HARNESSES
9ft(?)
12ft.
7ft
5ft
FLOOR

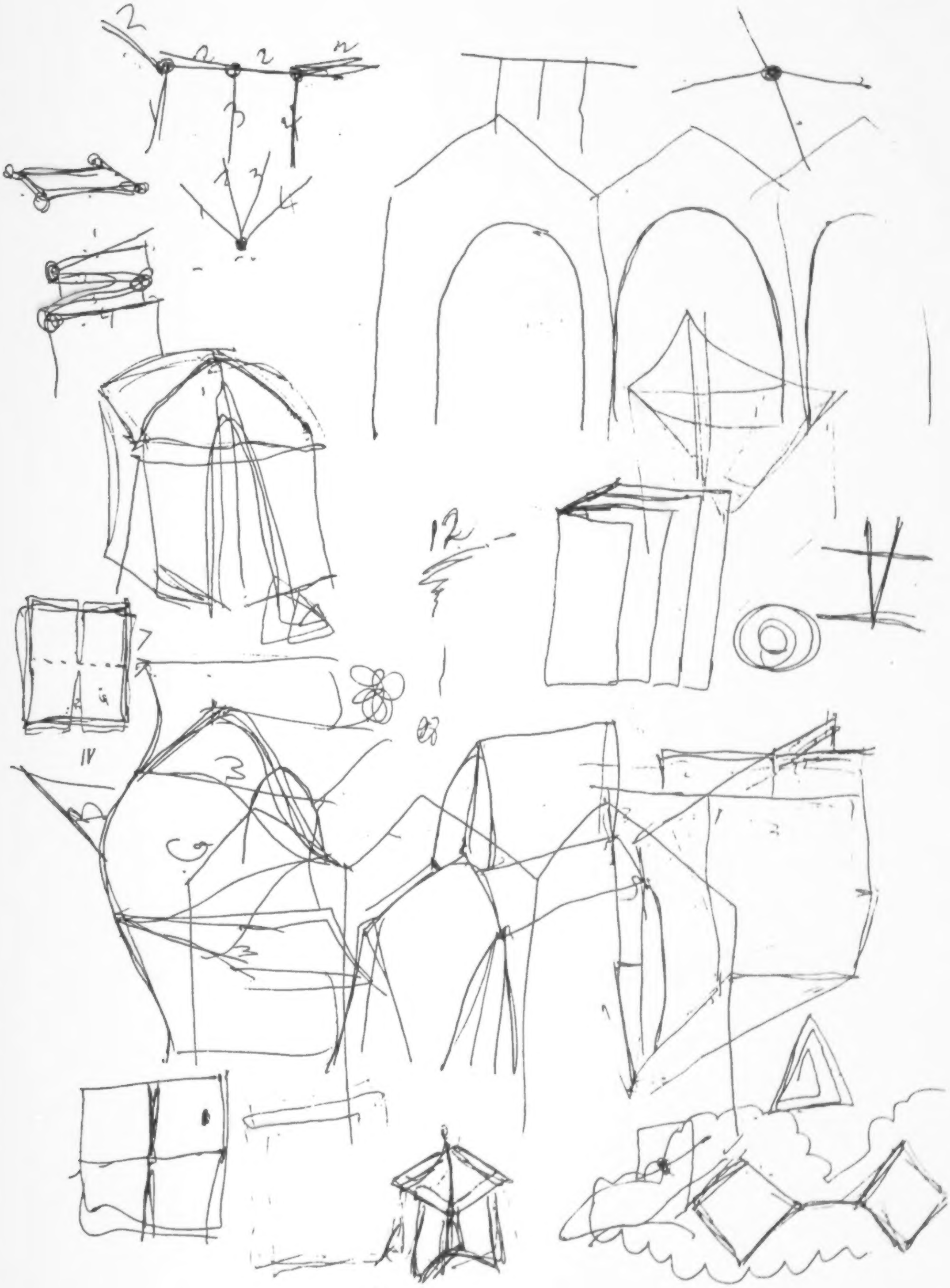
:h in Museums
ught to you by
›n

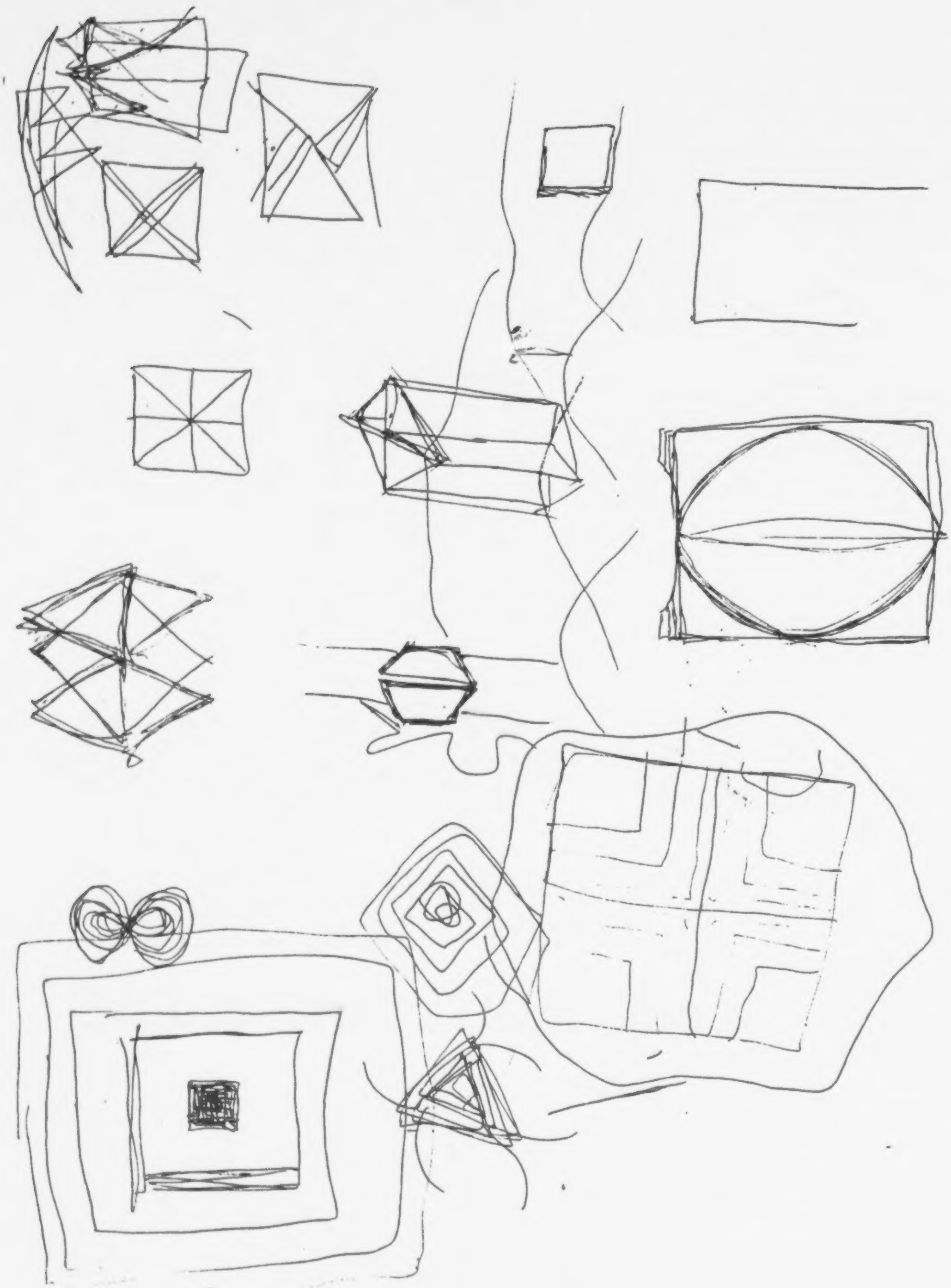
sted in attracting new audiences as they
›rtance of acknowledging and exploring
vays of interpreting and presenting
search. Community based research is
:ultural, spiritual, linguistic) is tied
world. This sense of group reality needs
n order to make that community feel
:alizing the need to involve a variety of
d exhibit development; a museum is

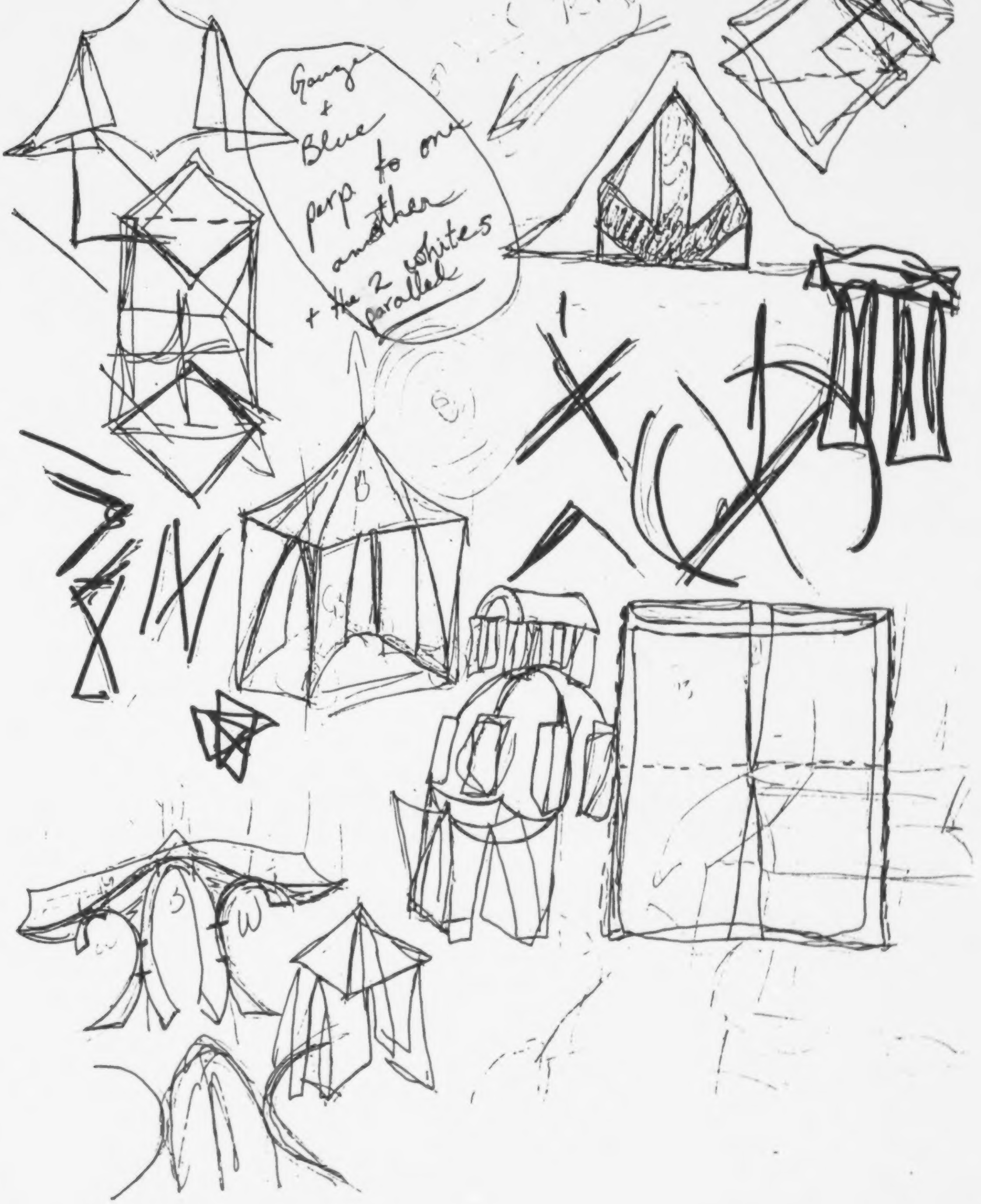



10
HARNESSES


From The desk of
Gail Redmond

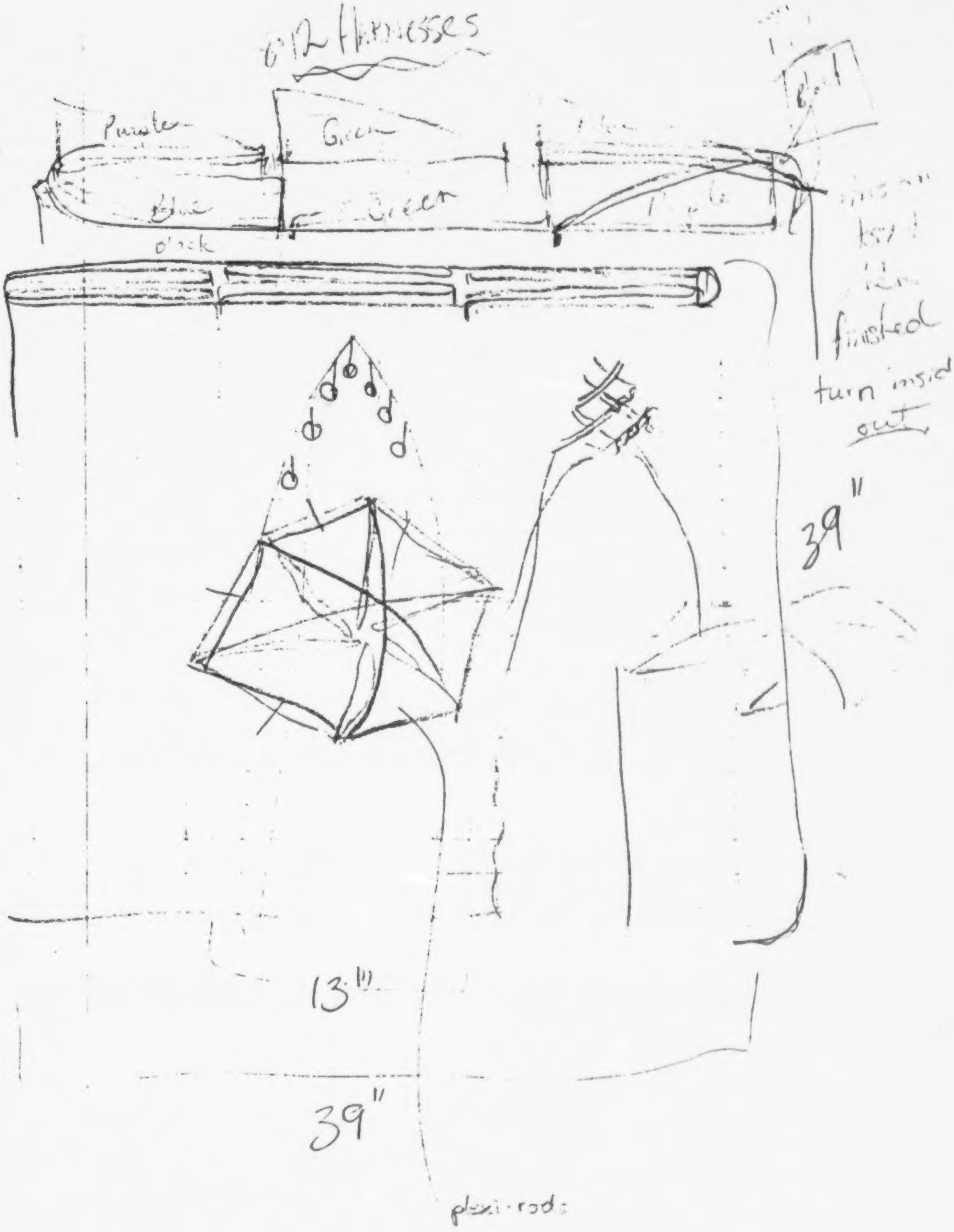

2
2
2
2
3
4
1
3
4
12
IV
3
3




Orange
+
Blue
perp to one
another
+ the 2 whites
parallel
B
B
B
B
W
W

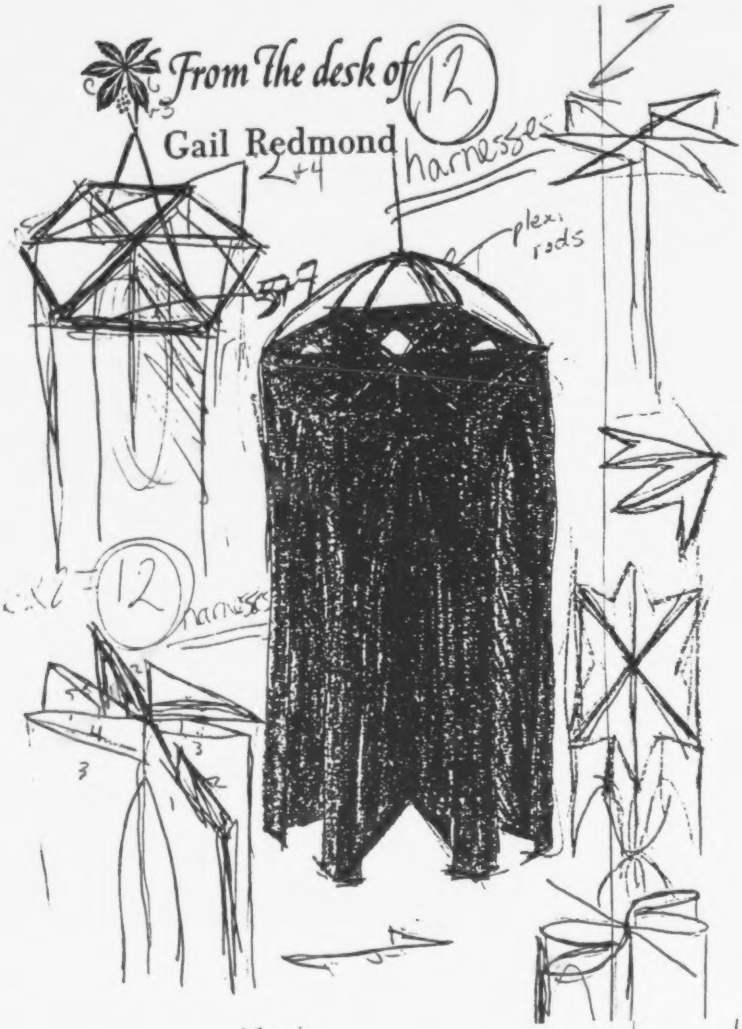
Appendix B:

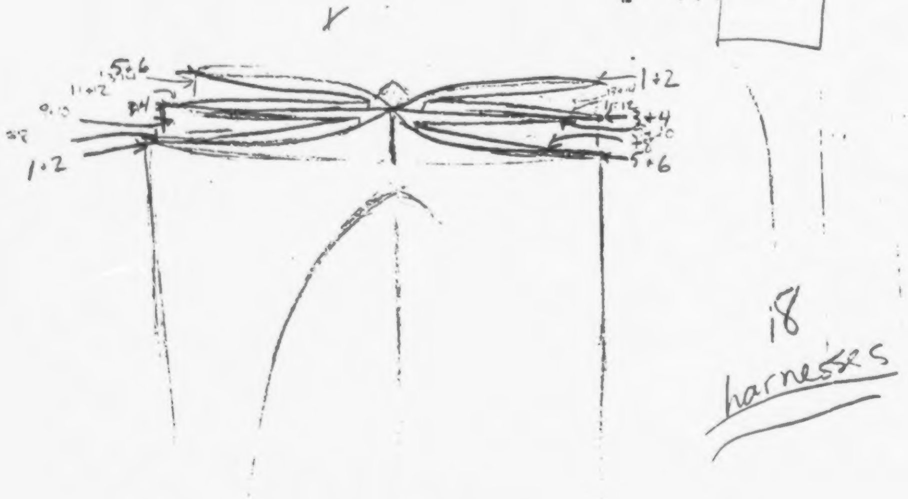
I chose the following sketches from the visualization ideas that I felt were more successful. These sketches are finished with more detail and illustrate my technical solutions to warp and weft placement problems. Some of these solutions included various structural arrangements, possible scale measurements, thread calculations, number of harnesses needed, and colour combinations. I constantly referred to these finished drawings and structural solutions during my intuitive process.


12 Harnesses
Purple
Green
Blue
Green
black
Purple
finished
turn insid out
39"
13"
39"
plexi-rods

From The desk of

Gail Redmond


12
harnesses
2+4
5+7
plexi rods
6×2 = 12 harnesses
1
2
3
4
5


5+6
13+14
11+12
9+10
3+4
7+8
1+2
1+2
13+14
11+12
3+4
9+10
7+8
5+6

18 harnesses

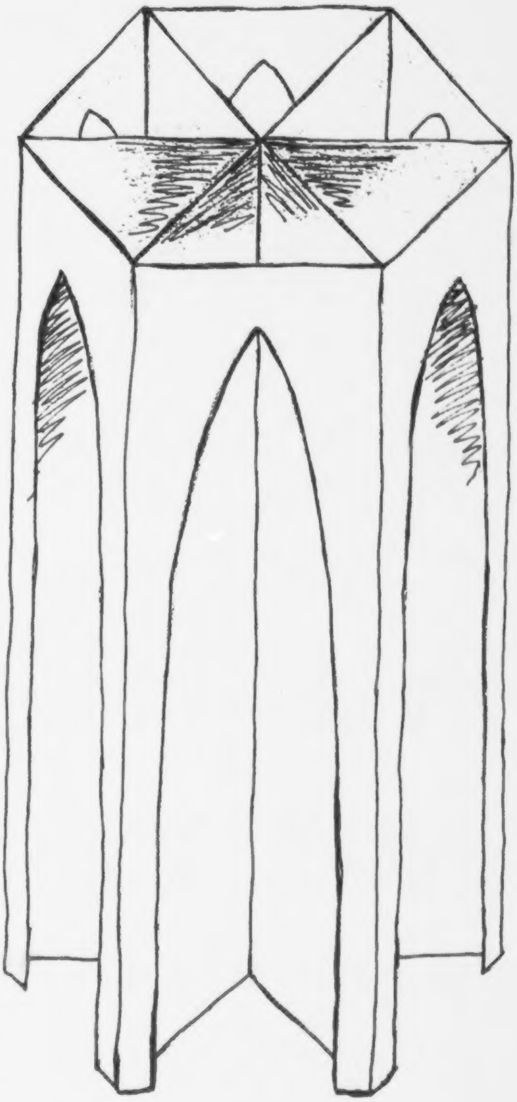
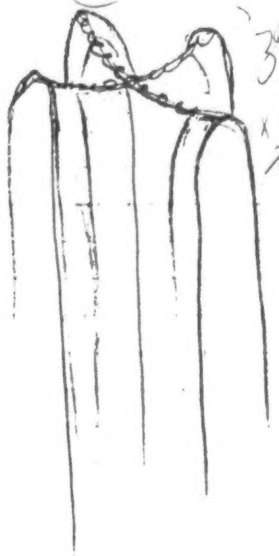


Figure 95. Three-dimensional design based on an architectural form that would utilize twelve or eighteen harnesses (Sketch by J.A. Renzi, 1993).

39"
x20
0
78
780/layer



39
x2
78
10"/panel sect.
78

6
x5
=30

6.5
6)39
36
30

13
3)39
39

6.5x3 =
19.5

10"
10"
10"
10"
10"
10"

20 epi

39" long

39" wide

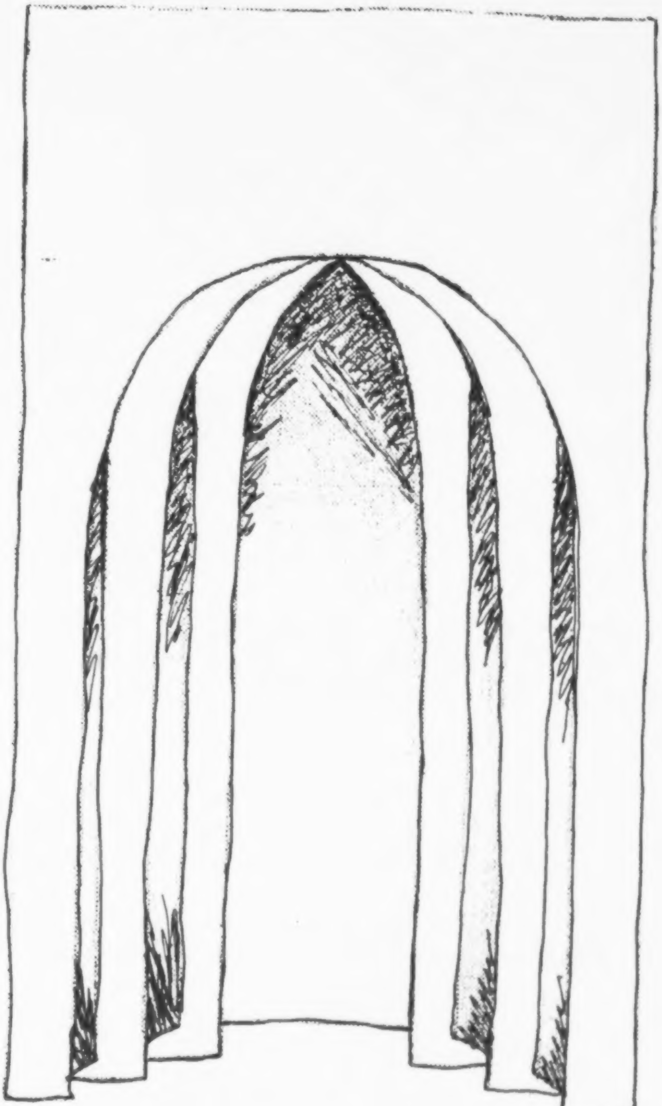
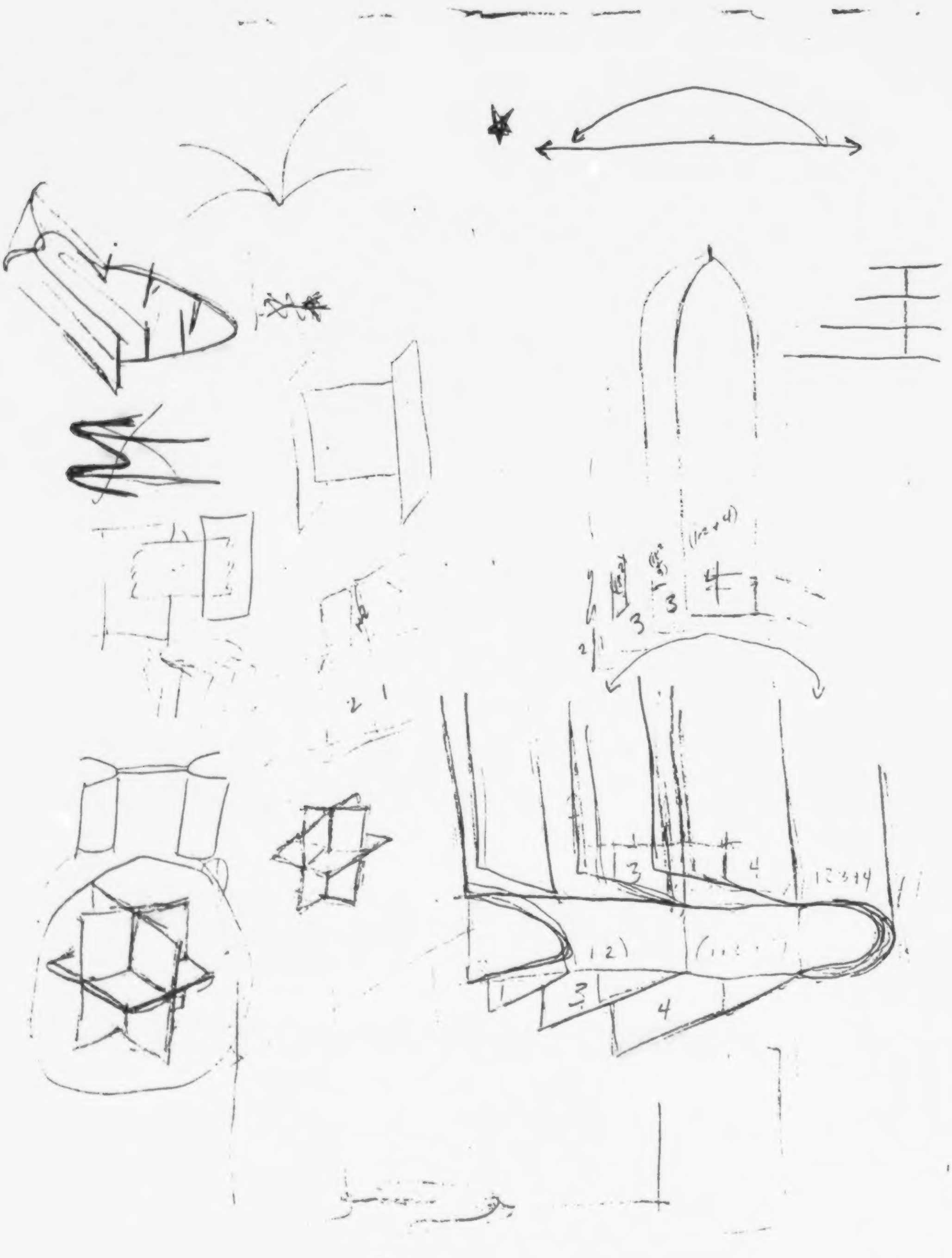
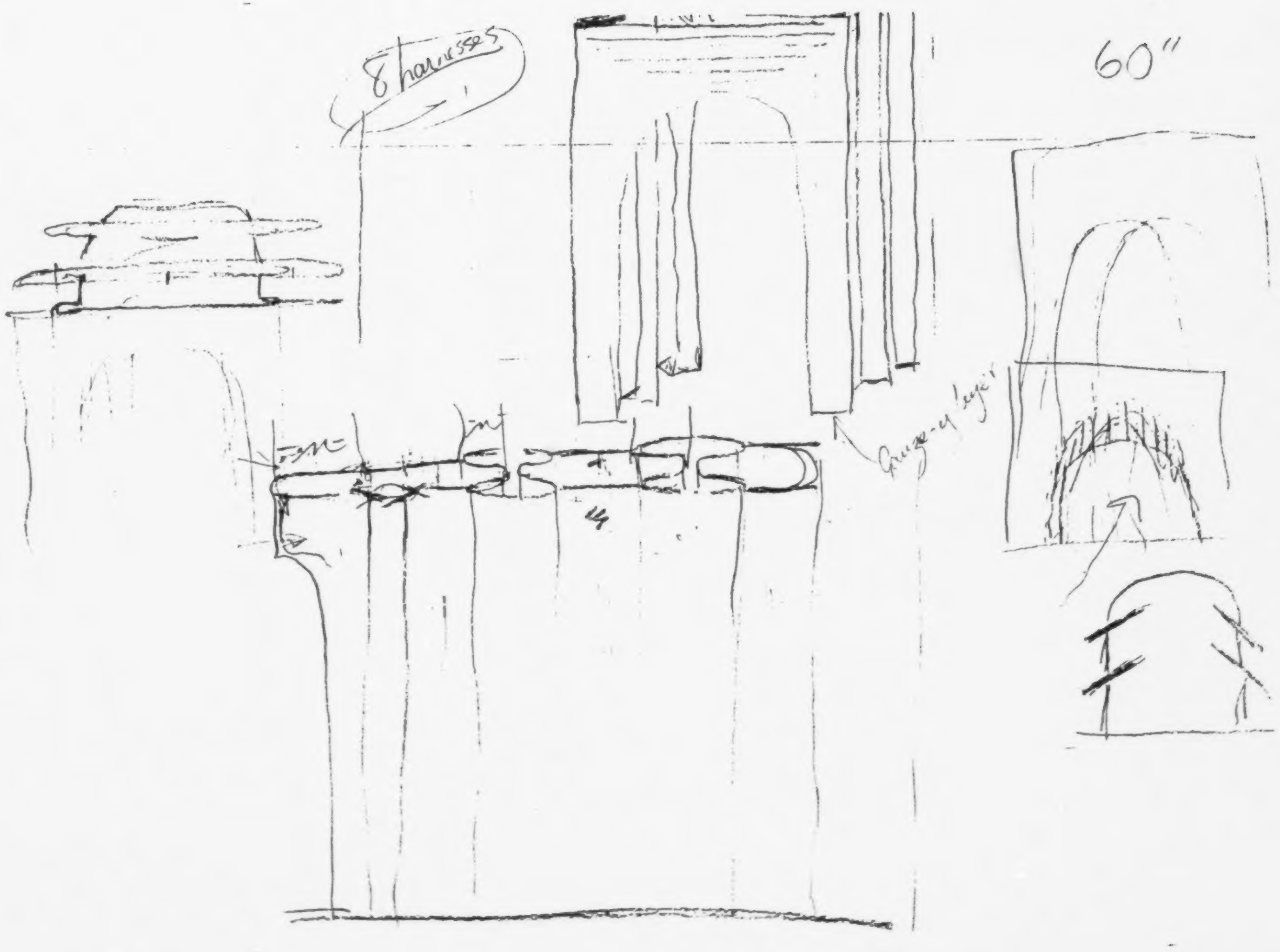


Figure 96. Three-dimensional design based on a tent form that I adapted for Textile#2 (Sketch by J.A. Renzi, 1993).


(1+2+4)
3
3
4
2
2 1
3
4
1·2·3·4
1 2
(1+2+4)
1
3
4


60"
8 harnesses
Gauze-y layer
ext
int
4

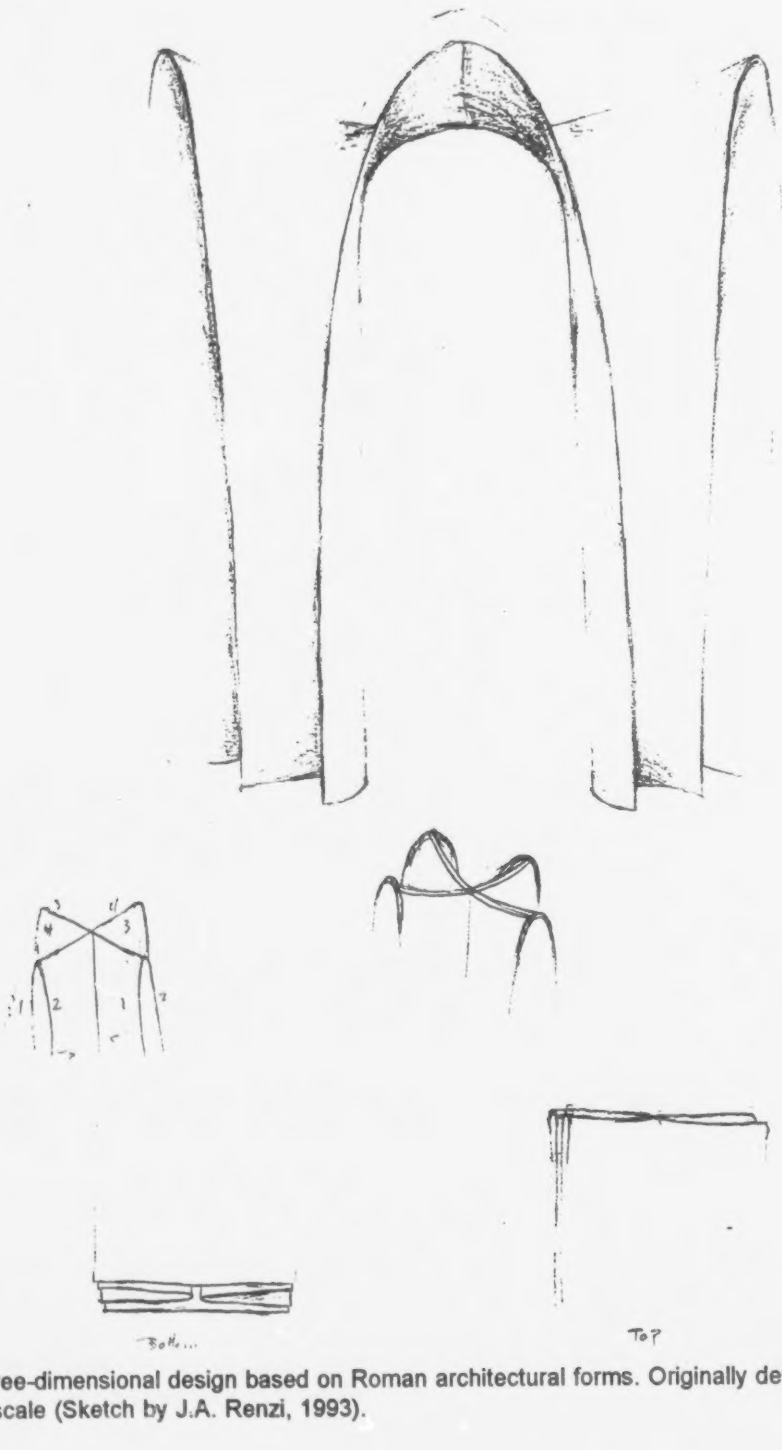
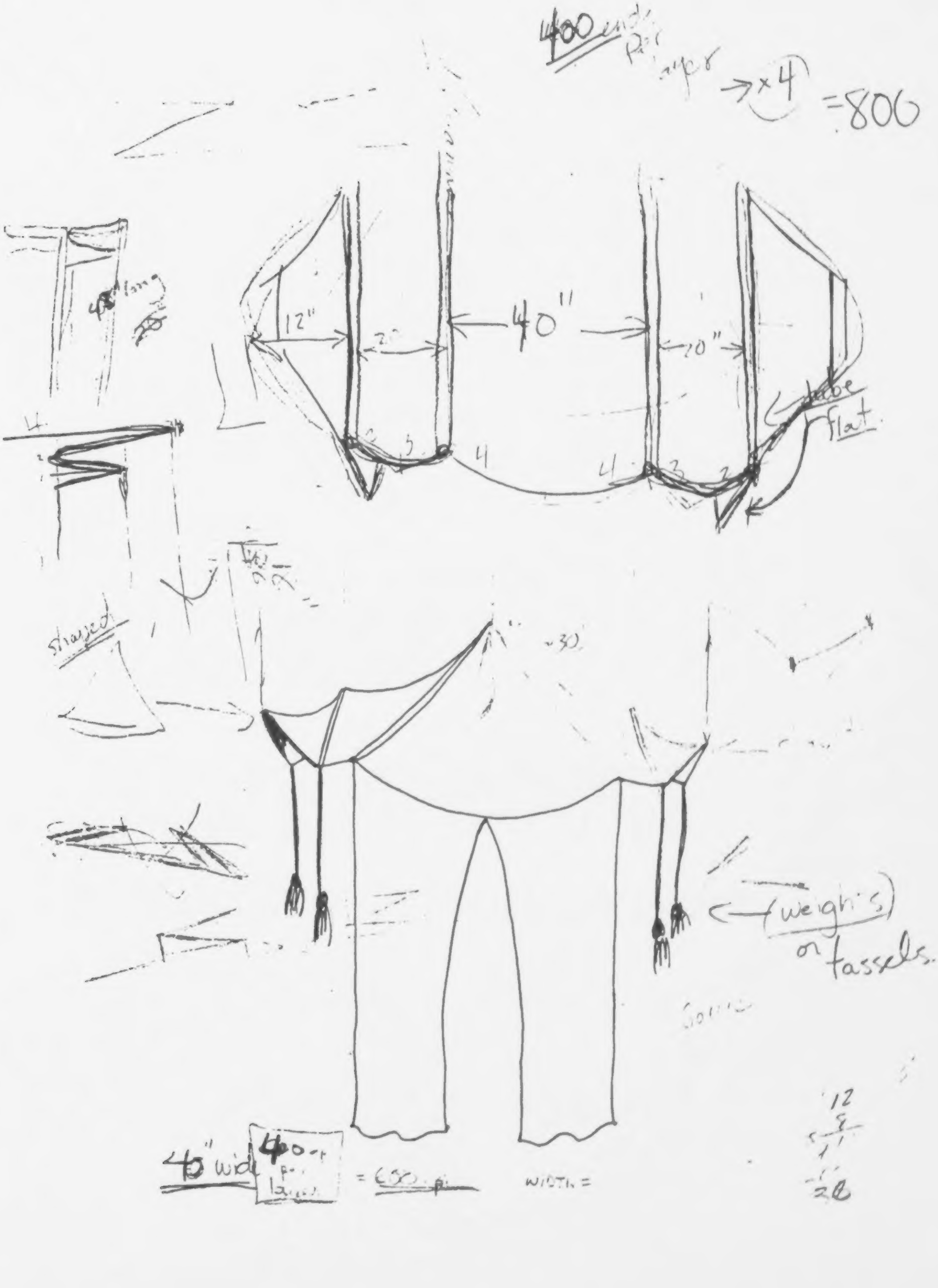
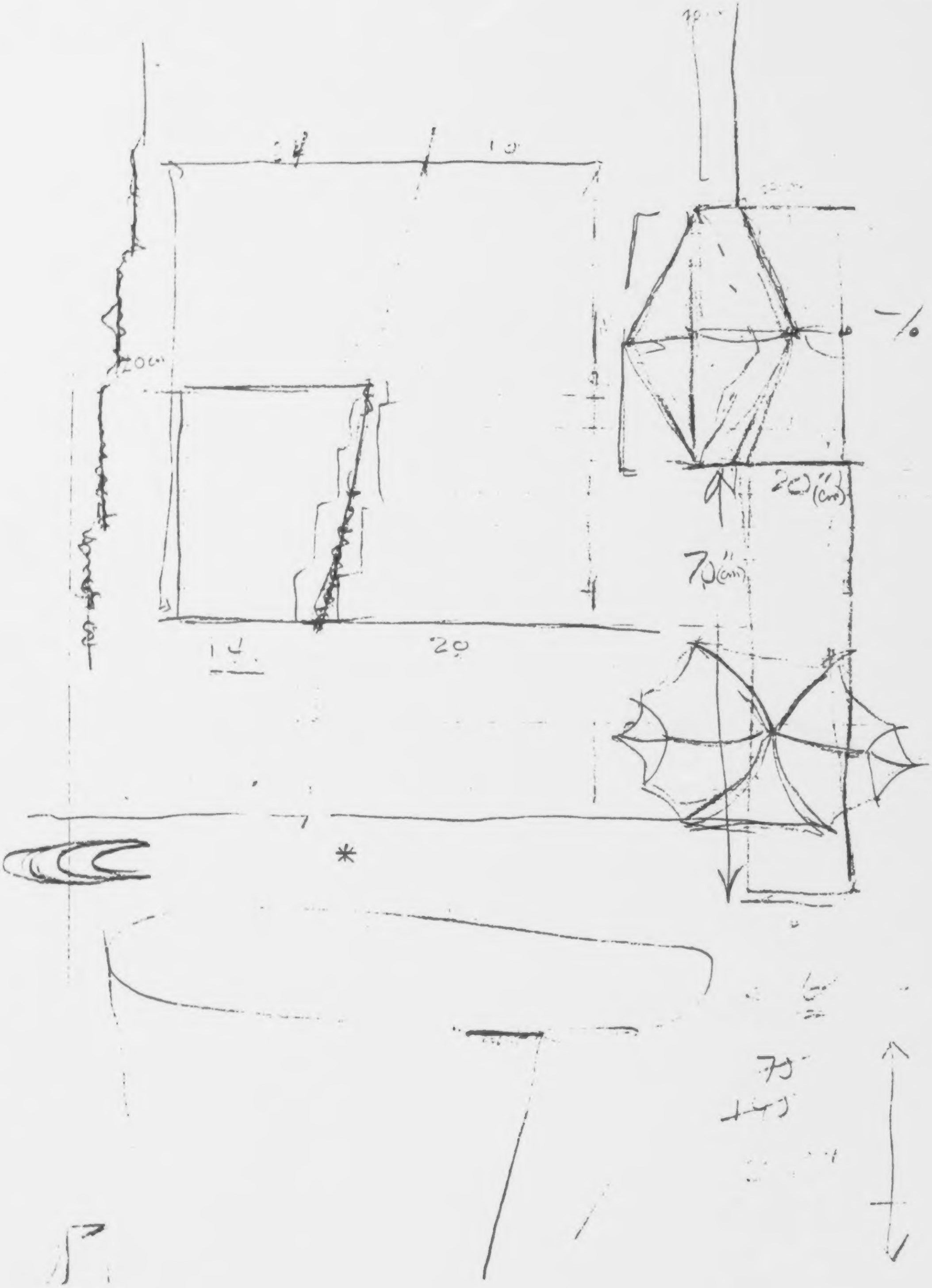

3
4
3
4
4
3
1
2
1
2
Bott...
Top

Figure 97. Three-dimensional design based on Roman architectural forms. Originally designed to be human-scale (Sketch by J.A. Renzi, 1993).


400 ends per layer
→ ×4 = 800
48" long
4
12"
20"
40"
20"
tube flat
2
3
4
4
3
2
shaped
30
(weights) on tassels.
40" wide
400 ends per layer
= 600 pi
WIDTH =
12
8
1
1
28


24
10
20cm
14
20
7%
20"(cm)
70"(cm)
*
75
145

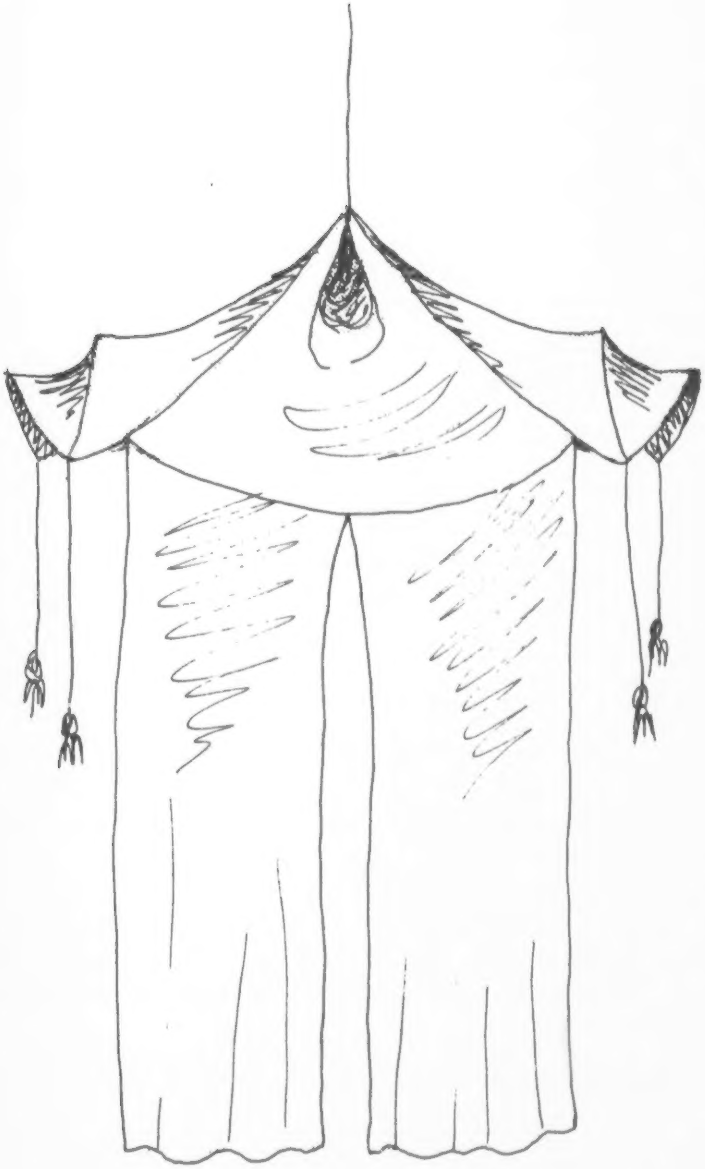


Figure 98. Three-dimensional design based on middle-eastern tent and asian architectural forms (Sketch by J.A. Renzi, 1993).

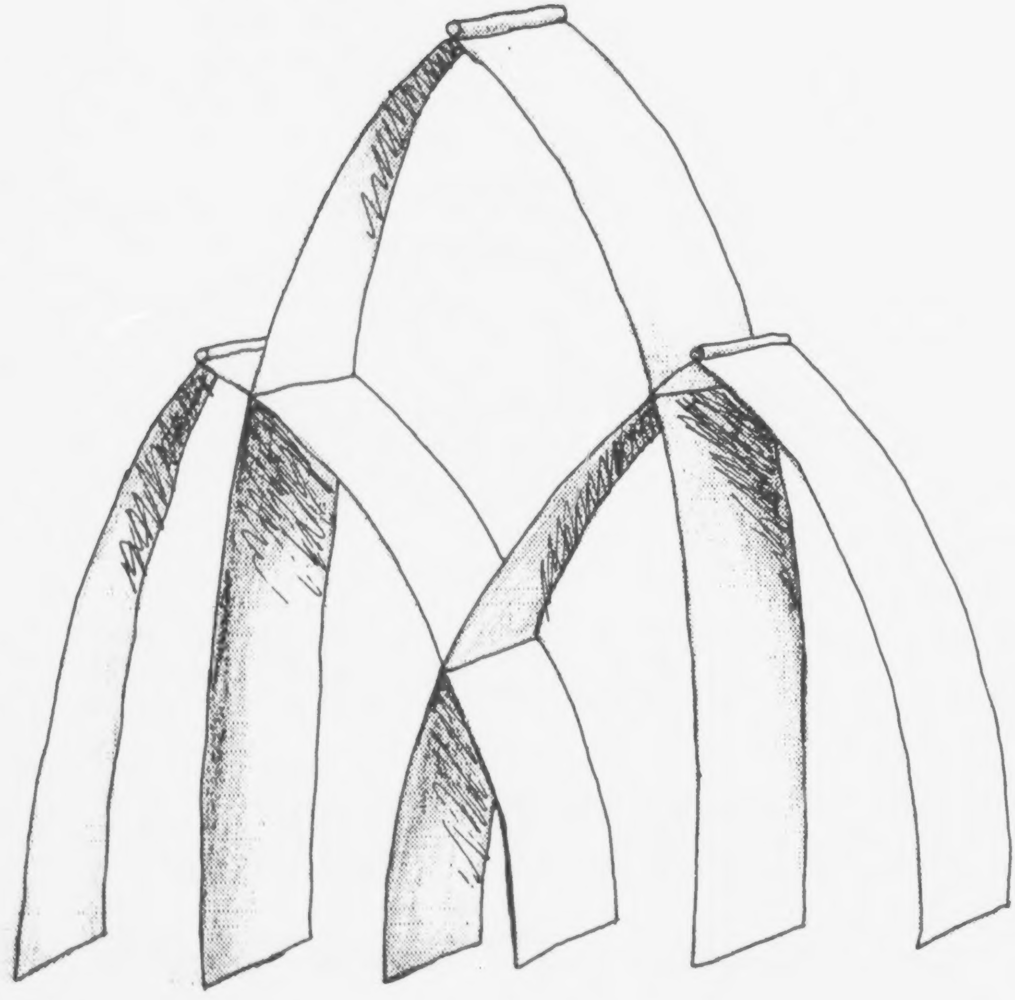
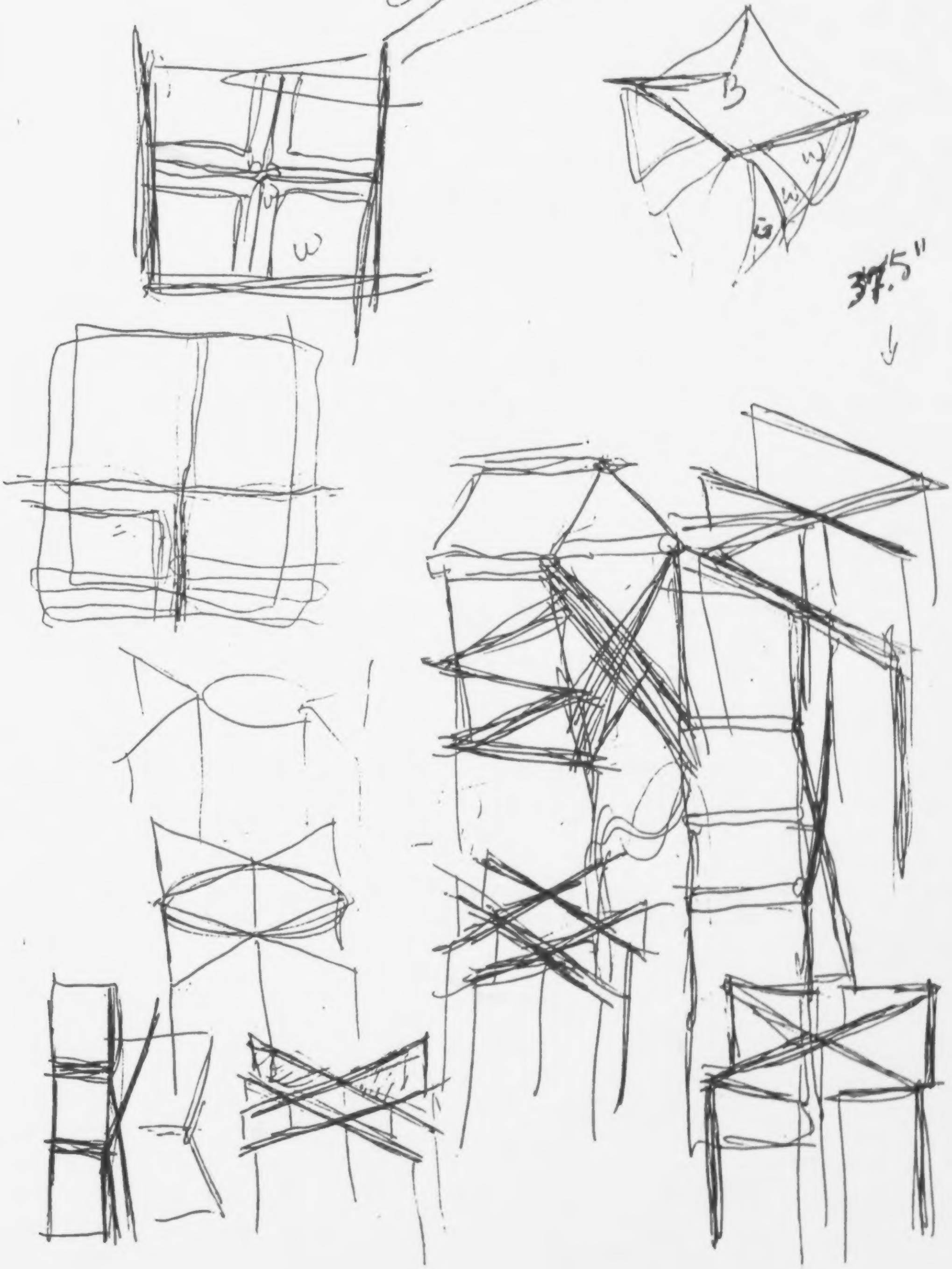


Figure 99. Three-dimensional design based on mountains and Gothic cathedrals (Sketch by J.A. Renzi, 1994).

8 harnesses 1/2" intervals

37.5"



Appendix C:

I have included charts taken from Loom Controlled Double Weave by Paul R. O'Connor (1992) as a reference for novice and experienced weavers. The following charts depict the possible multi-layered weave structures that can be created using multi-harness looms. These charts have been reproduced with permission from the artist and the publisher.

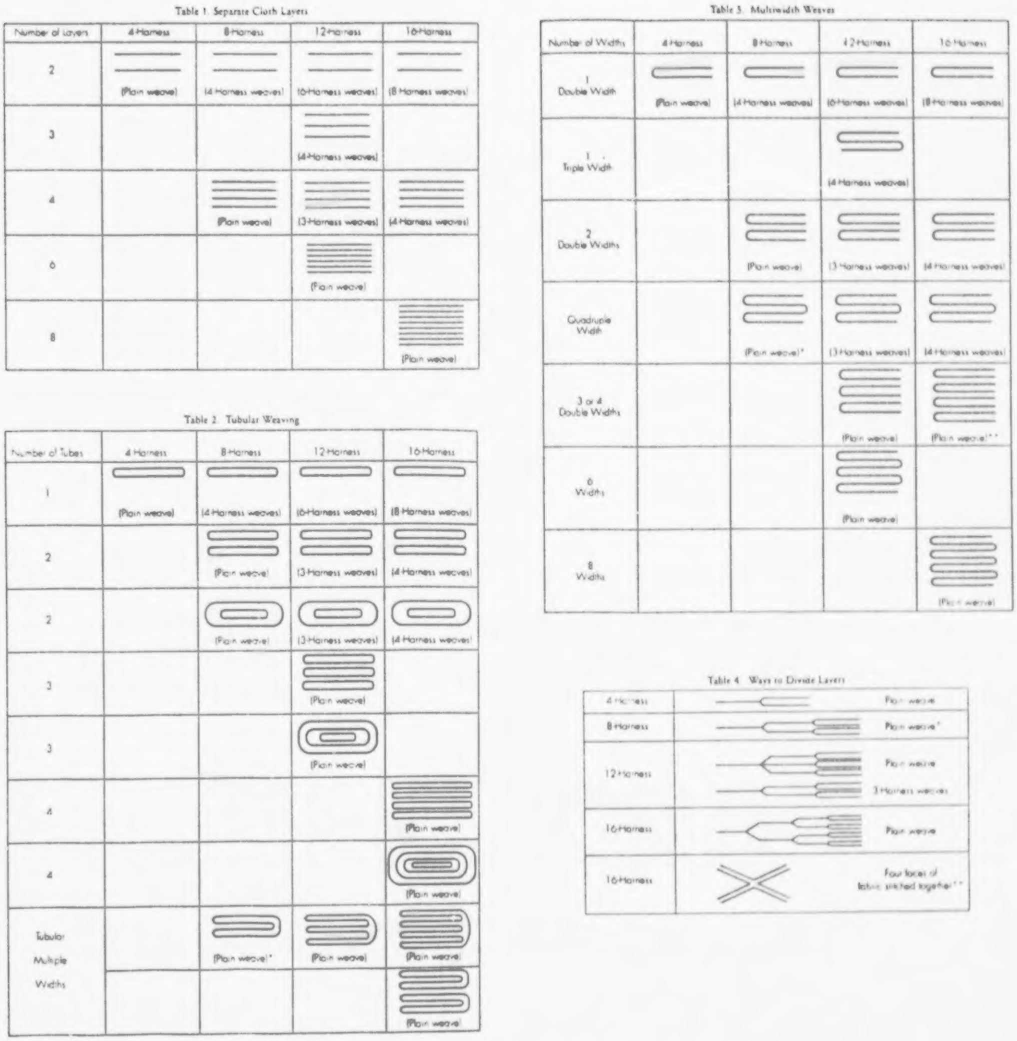


Table 1. Separate Cloth Layers

Number of Layers	4-Harness	8-Harness	12-Harness	16-Harness
2	(Plain weave)	(4-Harness weaves)	(6-Harness weaves)	(8-Harness weaves)
3			(4-Harness weaves)	
4		(Plain weave)	(3-Harness weaves)	(4-Harness weaves)
6			(Plain weave)	
8				(Plain weave)

Table 2. Tubular Weaving

Number of Tubes	4-Harness	8-Harness	12-Harness	16-Harness
1	(Plain weave)	(4-Harness weaves)	(6-Harness weaves)	(8-Harness weaves)
2		(Plain weave)	(3-Harness weaves)	(4-Harness weaves)
2		(Plain weave)	(3-Harness weaves)	(4-Harness weaves)
3			(Plain weave)	
3			(Plain weave)	
4				(Plain weave)
4				(Plain weave)
Tubular Multiple Widths		(Plain weave)*	(Plain weave)	(Plain weave)
				(Plain weave)

Table 3. Multiwidth Weaves

Number of Widths	4-Harness	8-Harness	12-Harness	16-Harness
1 Double Width	(Plain weave)	(4-Harness weaves)	(6-Harness weaves)	(8-Harness weaves)
1 Triple Width			(4-Harness weaves)	
2 Double Widths		(Plain weave)	(3-Harness weaves)	(4-Harness weaves)
Quadruple Width		(Plain weave)*	(3-Harness weaves)	(4-Harness weaves)
3 or 4 Double Widths			(Plain weave)	(Plain weave)**
6 Widths			(Plain weave)	
8 Widths				(Plain weave)

Table 4. Ways to Divide Layers

4-Harness	Plain weave
8-Harness	Plain weave*
12-Harness	Plain weave 3-Harness weaves
16-Harness	Plain weave
16-Harness	Four faces of fabric stitched together**

Figure 100. O' Connor's tables outlining the possible multi-layer weave structures that can be achieved on multi-harness looms (O' Connor, 1992, pp.23-26). Reprinted with permission from the artist.

Joëlle Angela Renzi

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EDUCATION

September 1992 - January 1996
MSc, Textile Design
UNIVERSITY OF ALBERTA, Dept. of Human Ecology
Edmonton , Alberta

September - November 1991
Diploma in Computer Aided Design for Textiles
FUJISTUDIO ART WORKSHOP
Florence, Italy

July - September 1991
Certificate in Jacquard design & loom operation
FONDAZIONE ARTE DELLA SETA LISIO
Florence, Italy

September 1987 - April 1991
BFA, Textile Design & Art History
NOVA SCOTIA COLLEGE OF ART&DESIGN
Halifax, Nova Scotia

SCHOLARSHIPS AND AWARDS

1995	*Alberta Museums Association Individual Training Grant
1994	*Handweavers Guild of America Scholarship
1992	*Nova Scotia Talent Trust Scholarship *Province of Nova Scotia Government Bursary
1987	*Nova Scotia College of Art and Design Centennial Entrance Scholarship *Kiwanis Club Bursary, Sydney, NS *Khattar and Khattar Law firm Bursary, Sydney, NS *City of Sydney Scholarship, Nova Scotia

LANGUAGES AND SKILLS

1st Language: English
Other: **Italian & French (spoken and written)**

COMPUTER OPERATION:
IBM - WordPerfect 6.1 for Windows, SPSS for Windows, Power Point, ScanJet IIcx,PhotoStyler, CLIO & CHIN Databases;
Mac - MacWord, various graphics programs.
COMPUTER WEAVE PROGRAMS:
IBM - Patternland Weave Publisher 2.0
- Weave Planner (AVL)
Mac - Design and Weave

WORK EXPERIENCE

UNIVERSITY OF ALBERTA, CLOTHING AND TEXTILES (CLTX) COLLECTION
July - August 1994
Registration Assistant
Responsibilities: Upgraded authority lists for adding data to the decorative technique and material technique fields; edited existing catalogue information; conducted a selective inventory and upgrade of location records; entered data into fields in the computer catalogue; designed new storage area for boxed storage in the collection; gathered price estimates of available shelving units; and compiled storage information for grant application.

September 1993 - December 1994
Graduate Assistant to Prof. Anne M. Lambert, Curator of the U of A, Clothing and Textiles Collection
Project: Preliminary research of historical reproduction textiles and the companies that produce them for an upcoming exhibit and symposium of the same, designed and executed public museum displays for the Collection.

September 1992 - December 1995
Collection Supervisor (Volunteer)
Responsibilities: Monitor the collection and maintain conservation standards, provide historic textile information and research, receive donations, give tours.

PROVINCIAL MUSEUM OF ALBERTA, Edmonton, AB
September - October 1993
Student Group Project (Volunteer): Conducted critical evaluation of Military Collection storage area, construction of storage mounts for military headgear, and written report.

FORTRESS OF LOUISBOURG, NATIONAL HISTORIC SITE, DEPT. OF ARCHAEOLOGY, Nova Scotia
June - August 1993
Preventive Conservation project (Volunteer): Worked independently under the supervision of the head of the archaeology dept., transferred archaeological textile fragments to proper archival storage conditions; documented textile structures and possible fibre identifications; produced a written condition report and photographic slide record.

WORK EXPERIENCE (cont'd)

SOUTH HAVEN GUILD OF WEAVERS, SPINNERS AND DYERS, Baddeck, Nova Scotia
March - June 1992
Computer Aided Weaving and Design Instructor
Responsibilities: Implemented and directed computer weaving and design course, aided in the development of a small textile industry in the Baddeck area.

PROFESSIONAL MEMBERSHIPS

Subversive Textiles Association of Artists (SUBTEXT)
Alberta Craft Council (ACC)
Alberta Museums Association (AMA)
Museum for Textiles, Toronto, ON.

SHOWS AND EXHIBITIONS

GRANDIN ARTISTS COLONY, Grandin Mall, St. Albert
November 1995
A Taste of St. Albert:Public show of my three-dimensional textile forms

UNIVERSITY OF ALBERTA
January 1996
3-D: Handwoven, three-dimensional, multi-layered textile forms
Installation of my thesis works

March 1994
Research Revelations '94
Design and installation of exhibit of basket forms from Panama to research presentation "Ecotourism and Fibre Craft in Darien, Panama" by Prof. A. Lambert

October 1994
Homecoming
Design and installation of museum artifacts for the CLTX Collection.

December 1993
Elements and Principles of Design: Women's Accessories (1947-70)
Student collaborative installation and design of CLTX Collection Exhibit.

EDMONTON SPACE AND SCIENCE CENTRE
September 1994
East African textiles from the CLTX studio Collection, at the opening reception for the IMAX film "The Serengetti".

ANNA LEONOWENS GALLERY,
January 1991
Undergraduate Studio Textiles: five textiles students' fibre art

October 1989
Painting Exhibit: Show of oil paintings

PRESENTATIONS & PUBLICATIONS

MUSEUMS REVIEW (Fall, 1995)
Journal of the Alberta Museums Association
Publication: "Ask an Expert" [Conservation Column]: Handling historic textiles.

UNIVERSITY OF ALBERTA
March 1994
Graduate Seminar: Literature review of textile history, theory and technique in the production of 3-D loom-woven sculptures.

September 1993
Graduate Seminar: Storage as Research: Archaeological textile fragments at the Fortress of Louisbourg.

January 1994
Craft Horizons Symposium
Presentation: Balancing computer and manual technologies in hand-woven textile production.

January 1993
Presentation: Wearable Art: The textile as art object.